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EDITORIAL.

The Quality of Malayan Copra.

During the past year, several articles concerning copra production have appeared in this Journal. Some of our readers, who happen not to be interested in this crop, may be of opinion that undue prominence has been given to this subject. In view of the fact that the area under coconuts in Malaya exceeds 600,000 acres and the value of the net exports in 1930 was over $15,300,000 the policy of this Department is to examine every aspect of the industry as we are convinced that improvements might be effected in the cultivation of the crop and the preparation of the copra which will greatly improve the quality, quantity and therefore the value of the product.

Part of the cost of our investigations on copra production is met by the Empire Marketing Board, so that we not only carry out these investigations for the benefit of Malayan producers, but as custodians of an Imperial research it is our duty to give adequate publicity to the progress of the work for the benefit also of other parts of the Empire.

With the present number of the *Malayan Agricultural Journal* we conclude a series of three consecutive articles, viz. The Economic Aspects of Coconut Research; Factors of Quality in Copra; and Types of Malayan Copra, which together with the brief review of the past six months' work by the author, Mr. F. C. Cooke, which also appears in this number, brings up to date the progress of these investigations.

The planter will ask himself how far these investigations have a practical application and whether improvements in the quality of his product will result in an enhanced price commensurate with the extra cost of production.

Before answering these points it is as well to enumerate the chief points that emerge from these investigations. They are as follows:—

(*a*) Picking of under-ripe and over-ripe nuts results in a certain loss of crop.

(*b*) Nuts of optimum ripeness yield copra of the best quality.

(*c*) Incompletely dried copra deteriorates rapidly by reason of attack by insects and moulds.

(*d*) By reason of deterioration from the above causes there is an actual loss of weight of copra.

In view of the fact that the price paid for copra by local buyers takes into account not only its present quality but the anticipated loss of weight before it reaches the crushing mill, the producer may therefore expect to receive a larger return for his copra if it is properly harvested and correctly dried.

Owing to the character of the Malayan climate, it is not possible to rely on sun-drying as a stage in the production of copra in the same way as in Ceylon or on the Malabar Coast. Malayan producers are therefore faced with the problem of producing by artificial drying alone, a copra in appearance equal to that of Ceylon or Malabar where the employment of sun-drying as a regular stage in the production of copra is practised.

The opinion is generally held that artificial means of drying copra cannot result in a product equal in colour to that of sun-dried copra. It would seem, therefore, that the first result of the application of the recommendations made by this investigator will result in an improvement in oil content and keeping qualities rather than an improvement in appearance. This is an unfortunate conclusion as the market judges quality very largely by appearance.

Satisfactory kiln drying necessitates a very considerable amount of supervision in order that an even temperature may be maintained, and it is apparent that the major part of the copra prepared in Malaya is unsatisfactory in quality by reason of faulty drying by artificial means.

Future research in copra production will therefore concern itself with an examination of the present systems of drying copra by artificial means. It is premature to state what the outcome of this work may be, but it seems likely that it will result in recommendations which may necessitate a re-adjustment of the present ideas on this subject.

Padi Soils. A review of the work in this and other countries on the subject of soil conditions suitable for padi cultivation was contributed by Mr. W. N. C. Belgrave at the Second Inter-Departmental Agricultural Conference held at Kuala Lumpur in October of last year, and is published in this number.

In view of the desirability of increasing the area under this crop in Malaya and of improving yields by the application of modern research, the subject is important.

If the figures of yields adduced may be relied upon as an indication, it would appear that, given adequate and controlled water supply, possibly existing ideas concerning the importance of soil type as a predominating factor in conditioning yields may have to be modified.

Formerly, it was thought that very heavy soils were essential for wet padi cultivation, but it would now appear that the successful exploitation of soils of a coarser texture may be possible.

Tung Oil. The use of Chinese wood oil in the manufacture of paints and varnishes has been given much prominence during recent years.

In this number, Mr. B. Bunting gives a concise account of the cultivation of the tree Aleurites spp. and the production and quality of the oil which is obtained from the seeds. Further, a statement is made of the experiments carried out by the Department of Agriculture on the cultivation of Aleurites. The important conclusion is reached that neither *Aleurites Fordii* nor *A. montana* are suited to cultivation on the plains of Malaya. It is possible that the hills of this country may prove more suitable, but unless experiments now in progress at Cameron's Highlands shew that at this elevation (5,000 feet) the tree will flourish, the cultivation of this crop on a commercial scale is not recommended.

Stem-rot of Oil Palm. In this number of the *Malayan Agricultural Journal* we take the somewhat unusual course of publishing an extract from a forthcoming Special Bulletin of the Department on "Stem-rot of the Oil Palm in Malaya" by Mr. A. Thompson, which is now in the press.

It is considered, however, that the early publication of the portion on prevention and treatment is desirable in order that those concerned with planting oil palms may be in possession of the recommendations of the Department concerning this matter.

The author concludes that diseased trees may be cured if treated at an early stage. This method is costly, but inevitable when the disease is established.

The alternative would appear to be clearing the land of all jungle stumps and fallen timber as it is considered that the disease originates from fungi which grow on such timber. This recommendation is the outcome of the observation that there are at present no signs of stem-rot on the palms at the Government Experimental Plantation, where the land has been cleared of all timber and stumps.

It is, perhaps, premature to advocate the policy of clean-clearing as a preventative of stem-rot, but there is much to justify the policy; so that those concerned in this question would be well advised to examine the incidence of stem-rot on their plantation in relation to the amount of fungi found on the decaying jungle stumps and timber on the land.

TUNG OIL OR CHINESE WOOD OIL.

B. Bunting,

Agriculturist.

Tung oil, which is more commonly known as the Chinese Wood Oil of commerce, has of recent years become of increasing importance in the manufacture of paints and varnishes, particularly where a hard surface or a high gloss is required. The oil came into prominence during the War, when it was extensively used in the treatment of aeroplane fabrics. It is also employed in the manufacture of linoleum.

At the present time, the principal source of production of Tung oil is in China, where the value of the exports of this oil amount to over three million pounds sterling annually.

The following figures show the exports of Tung oil from China during the period 1926 to 1928 :—

			Tons.	*Value.*
1926	...	...	44,535	£2,330,215
1927	...	...	53,648	3,095,371
1928	...	...	65,137	3,404,268

It may be of interest to record that America is the principal consumer of Tung oil and in 1929 the imports into the United States were 53,428 long tons, valued at £3,082,578. The imports into the United Kingdom for the same period amounted to 4,154 tons, valued at £273,350.

In view of the fact that the United Kingdom, as well as other countries, is entirely dependent upon China as the source of supply of Tung oil, a memorandum (1) on the production of Tung oil in the Empire has been prepared by the Imperial Institute and published under the auspices of the Empire Marketing Board with the object of investigating the possibilities of producing this oil by the cultivation of Tung trees within the Empire.

Sources of Tung Oil.

According to the above mentioned memorandum, there are two species of *Aleurites* which produce the Tung oil of commerce and the following information is given regarding the botanical nature of the plants and their distribution :—

"Tung oil is obtained from the seeds of *Aleurites Fordii* Hemsl., a tree which grows abundantly in central and western China. Another species, *Aleurites montana* Wils., found in south-eastern China, yields "Mu-yu" oil, which is stated to possess similar properties to those of Tung oil. These two oils, sometimes indiscriminately mixed, are exported from China under the name of Chinese Wood oil."

(1) "The Production of Tung Oil in the Empire," published by His Majesty's Stationery Office, London, June, 1930, price 1s. 0d. net.

"Our knowledge of the distribution of these two species is limited but there seems to be no doubt that *A. Fordii* furnishes the bulk of the Tung oil exported from China. *A. Fordii* is a quick growing, small tree which occurs in the warm temperate parts of China, especially in the Yangtze valley, where the Chinese grow small plantations on hill-sides on land unsuitable for ordinary cultivation. Here the summers are warm enough for such crops as rice and giant millet, while wheat is grown in the cold weather when slight frost and snow may occur on high ground. *A. montana* extends from the Province of Chekiang in south-eastern China to Tonkin in French Indo-China and the Shan States of Burma. The presumption therefore is that *A. Fordii* is likely to thrive best in climates which are less tropical than those which favour *A. montana* and that the latter species may require a heavier hot-weather rainfall than the former. Trials with the two species on the American continent seem to support this. In size, habit, foliage and general appearance the two species are similar; both are deciduous and shed their leaves at the commencement of the cold weather. In both, the fruits are roughly spherical and about 5 cm. in diameter, but they may be readily distinguished because the outer surface of the fruit of *A. Fordii* is smooth while that of *A. montana* has wavy transverse ridges. The fruit of *A. Fordii* has from three to five one-seeded segments while that of *A. montana* usually has only three."

"There are three other species of *Aleurites* which also bear oil-yielding seeds, namely, *A. cordata* Steud., the source of Japanese wood oil; *A. triloba* Forst. (= *A. moluccana* Willd.), yielding candlenut or lumbang oil, and *A. trisperma* Blanco. Their oils have not the same special properties as those of *A. Fordii* or *A. montana* and cannot replace them in the paint and varnish trade."

Climatic and Soil Conditions.

The following is a brief description of the conditions under which *A. Fordii* is found growing in its native habitat in China :—

"*Rainfall and Temperature.* As the tree is deciduous and flowers before producing its leaves, it appears probable that it will succeed best under climatic conditions affording it a resting period. For successful cultivation the absence of much frost and a sufficient rainfall are essential. The rainfall should not be less than 30 inches, 50 or even 70 inches being preferable. In Ichang, China, where this tree flourishes, the average rainfall is 30 inches, most of which falls in April, July and August. Here the climate is rather one of extremes. The summer is tropical with a shade temperature ranging from 90° to 110°F. The winter is cold, snow often lying on the ground for days, but there are seldom more than 4 degrees of frost. In the mountains, at 2,600 feet altitude, the summer is somewhat cooler and the temperature may fall to 24°F. and occasionally as low as 20°F. Experience within the Empire indicates that this tree is very resistant to drought and can withstand very high summer temperatures."

"*Soil.* In China the tree appears to have no strong predilection in the matter of soil, and grows equally well on conglomerate, hard limestone, sandstone or

sandy clay. It is essentially a hillside tree, thriving in the most rocky situations and in the poorest of soils. In America the tree has been tried on almost every type of soil, and has been found to grow on practically any well-drained soil which is slightly acid. The type of soil which is found most suitable in Florida is a sandy or sandy loam soil which is underlaid with clay 3 to 8 feet down."

The climatic conditions described above would appear to preclude the possibility of establishing *A. Fordii* successfully even on the hills in this country, more particularly if the plant requires a definite resting period.

In view of the interest which is now being taken in the possibilities of the production of Tung oil on a commercial basis a resumé of the information contained in the memorandum referred to above is given below :—

Cultivation of Tung Trees.

The common method of reproduction of *A. Fordii* is by seed, but the plant can be established by budding and grafting and also propagated from cuttings.

In China the trees are planted on waste hillside land and no attempt appears to have been made to grow them as a regular plantation crop in that country.

As a result of trials carried out by the United States Department of Agriculture it was found that *A. Fordii* fruited well in certain of the Southern States. In fact these trials were considered so satisfactory that in 1923 a company was formed by the American Paint and Varnish Manufacturers' Association with the object of proving that Tung oil trees could be grown successfully in America as a plantation crop. The first plantations were established at Gainsville, Florida and comprised an area of about 270 acres. In 1929, the area planted in Florida had increased to 5,000 acres, while an additional 500 acres have been planted in States other than Florida.

Planting Distance. From experience gained in Florida it is recommended that the trees be planted 30 ft. x 12½ ft. After the seventh year alternate trees are removed so that the distance in the rows is increased to 25 feet, which gives approximately 60 trees per acre.

It is stated that in China the trees rarely exceed a height of 30 feet and have a spread varying from 15 to 30 feet. In Florida eight-year-old trees frequently attain a height of 30 feet with a spread of about 28 feet.

Harvesting. The fruiting season in both China and Florida is generally about October.

In China the fruits are removed from the trees by means of poles before they are properly ripe. They are then placed in heaps, which are covered with straw or grass, and allowed to ferment. In the process of fermentation the outer husk is loosened, thus facilitating the removal of the seed.

The practice in Florida is to allow the fruits to ripen on the trees. When ripe they fall to the ground and are allowed to remain under the trees until quite dry.

Yield. In Florida the trees generally come into bearing about the fifth year and reach full bearing in their tenth year. Although it is too early at

present to form any reliable estimate as to the production of tung oil from trees grown under plantation conditions it is on record that six-year-old trees on a plantation in Florida produced a yield of approximately 1,300 lbs. of dry fruit per acre, which is equivalent to about 280 lbs. of oil per acre per annum.

Marketing the Produce. The nuts after being separated from the outer husks should be thoroughly air-dried and bagged for shipment. The nuts are composed of about 43 per cent. of shell and 57 per cent. of kernel. The kernels contain about 56 per cent. oil, which is readily expressed by the usual method of crushing in hydraulic presses.

It is considered that oil prepared in England would be of lighter colour and much superior in quality to the Chinese-made product, while its purity could be guaranteed. Further, it is stated that such oil would possibly command a premium over the Chinese product, which was quoted at £69-10s. per ton in London in January, 1930.

Departmental Experiments with Aleurites.

The Department of Agriculture, S.S. and F.M.S. has carried out numerous experiments with various species of Aleurites and the following information has been obtained regarding the growth of both *A. Fordii* and *A. montana* under Malayan conditions :—

(a) Aleurites Fordii.

Seeds of *Aleurites Fordii* were received from the Bureau of Plant Industry, Department of Agriculture, United States of America in January, 1914. These seeds germinated freely and the resultant seedlings were planted at the Government Experimental Plantation, Kuala Lumpur on an area of land adjoining the offices of the Department of Agriculture. Although the plants showed considerable promise at the start, after attaining a height of about 5 or 6 feet their growth was completely arrested and they soon developed a stunted appearance which clearly indicated that this particular species of *Aleurites* was totally unsuited to cultivation under local climatic conditions. In March, 1924, which was over 10 years from the date of planting, the Agriculturist then in charge reported as follows :— "Only four plants of this species now remain and they are in very poor condition, although they have been well cultivated and manured. The trees average 5 feet in height, have very few branches and are practically devoid of leaves." The plants in question never showed any signs of flowering and eventually their cultivation was abandoned.

It is intended to carry out further trials with this plant at the Experimental Plantation, Cameron's Highlands, which is situated at an elevation of about 5,000 feet above sea level, but the possibility of success at this elevation is somewhat doubtful, since the tree apparently requires a much cooler climate and a definite resting period for its proper development.

(b) Aleurites Montana.

Experiments at Kuala Lumpur. A small consignment of seeds of *Aleurites montana* was received from the Superintendent, Botanical and Forestry Depart-

ment, Hong Kong, in December, 1919. The seeds showed a very good percentage of germination and the seedlings were planted on terraced land at the Experimental Plantation, Kuala Lumpur at distances of 20 feet apart in March, 1920. The plants made vigorous growth at first, but after a time they became somewhat straggly and began to throw out numerous suckers near the ground. Measurements of the trees taken in March, 1923 showed that they ranged from 4 feet to 16 feet in height, while the girth varied from 6 inches to 14 inches at two feet from the ground. The wide variation in both height and girth indicates the general unevenness in the growth of the trees under this trial. Further measurments taken in January, 1924 showed that the girth of the trees varied from 7 inches to 22½ inches, but the average height was only 11 feet.

A few trees commenced to flower in January, 1924, which was about 4 years after planting but the majority of the flowers did not set, with the result that only one or two isolated fruits were produced. Since the trees showed no further signs of fruiting and a large number subsequently died, their cultivation was abandoned early in 1926, the experiment having proved a complete failure.

Experiments at Serdang. A further consignment of 735 seeds of *A. montana* was received at the Experimental Plantation, Serdang (2) from the Botanical and Forestry Department, Hong Kong in November, 1924. The seed, which was sown in boxes containing prepared soil, commenced to germinate about a month later and germination continued for a period of nearly two months, giving about 45 per cent. germination. As the seedlings developed they were removed from the seed boxes and transplanted into small bamboo baskets, which were kept under shade in nursery beds for a period of about two months.

A plot of land, comprising approximately 3½ acres, situated at the base of a steep hill was selected as being the most suitable area for this crop. The soil, which was fairly even throughout the area, may be described as a heavy laterite loam.

The basket seedlings were planted out in this area during March, 1925 at a distance of 20 ft. x 20 ft. square, which gives 108 trees per acre.

After planting, growth was fairly rapid, especially in the case of the trees planted on the lower part of the area. One tree commenced to flower in March, 1926 and a few mature fruits were collected in April, 1927, *i.e.*, two years after planting in the field. A number of trees flowered during 1927 and a small quantity of seed was collected during that year. Early in 1928 more trees flowered and in the following June 35 lbs. of seeds were harvested from five of the largest trees. At the end of 1928 the majority of the trees had reached the flowering stage, but only a small number were bearing fruit. The following is a record of the weight of cleaned nuts produced during the past three years from the area in question :—

(2) *Malayan Agricultural Journal,* Vol. XVII, 1929, page 47.

Year.	*Weight of cleaned seed.*
	lbs.
1928	34 lbs.
1929	30 „
1930	68 „

Flowering and fruiting occurs throughout the year but is more pronounced during the dry seasons, *i.e.* January—February and July—August.

The fruits are allowed to ripen on the trees and fall to the ground. They are then left under the trees until thoroughly dry when the husk of the fruit splits open from the base upwards and the seeds are easily extracted.

The records at Serdang show that 160 sun-dried seeds weigh one pound; which is approximately the same figure as the seed originally obtained from Hong Kong.

The following measurements, which were taken at the end of 1930, show to what extent the trees are likely to develop under the conditions obtaining on the plains in Malaya :—

Average height	=	18 feet.
Average spread	=	19 „
Average circumference at two feet from ground ...	=	20 inches.

The general behaviour of the individual trees is most erratic and specimens are to be found flowering, fruiting and wintering at the same time, which may possibly be due to the absence of a definite resting period. It has also been observed that so far the number of female flowers produced is proportionately small and this naturally affects the crop.

The yields of fruit to date have been extraordinarily poor considering the age of the trees and it would appear that this particular species of *Aleurites* is also unsuited to the conditions prevailing on the plains in Malaya.

The following information has been published by the Department (3) regarding (a) the oil content and (b) the analytical constants of oil from seeds of *A. montana* produced at the Experimental Plantation, Serdang :—

Oil Contents of Seed.

Average weight of seed	2.8 grammes.
	per cent.
Proportion of shell	47.2
Proportion of kernel	52.8
Kernel.	
Moisture (loss at 100°C.)	5.4
Oil (petroleum ether extract)	43.2
Residue (by difference)	51.4
Oil (calculated on moisture-free basis) ...	45.7
Seed.	
Oil (calculated on whole seed)	22.8

(3) *Malayan Agricultural Journal*, Vol. XVI, 1928, page 297.

Analytical Constants of Oil.

Constant.	*Oil from A. montana.*	*Chinese Wood oil.*
Oil.		
Specific gravity at 15.5°C.	0.939	0.935 —0.940
Refractive index at 20°C.	1.5098	1.5179
Saponification value	195.5	193.0
Iodine value (Wijs)	160.3	170.6
Acidity (Oleic Acid per cent.) ...	1.8	
Unsaponifiable (per cent.)	0.6	
Fatty Acids.		
Solidifying point (Titer value) ...	36.8°C.	37.2°C.
Mean molecular weight	298.4	297.1
Neutralisation value	188.0	188.8
Iodine value (Wijs)	164.7	144 — 159

The figures for Chinese Wood oil are taken from "*Chemical Technology and Analysis of Oil, Fats and Waxes*", Lewkowitsch and Warburton, Vols. I and II, for purposes of comparision.

It will be observed from the above figures that the physical and chemical constants of the oil from *A. montana* agree closely with those of Chinese Wood oil except for a small difference in the iodine value.

Conclusions.

As a result of the various trials carried out by the Department with *A. Fordii* and *A. montana* at the Experimental Plantations, Kuala Lumpur and Serdang, it would appear that both these species of Aleurites are unsuitable for cultivation on the plains in this country. Further trials, however, are being carried out at the Experimental Plantation, Cameron's Highlands at an elevation of about 5,000 feet and until such trials have proved successful the cultivation of either *A. Fordii* or *A. montana* on a commercial scale in Malaya cannot be recommended.

Departmental Publications on Aleurites.

The following is a list of articles published by the Department of Agriculture, S.S. & F.M.S., on the various species of Aleurites :—

1. "Tung Oil or Chinese Wood Oil and Candlenut Oil from Aleurites Spp." by B.J. Eaton,—*Agricultural Bulletin, F.M.S.*, Vol. VII, 1919, page 162.
2. "Oil from Aleurites Species" by C.D.V. Georgi.—*Malayan Agricultural Journal*, Vol. X, 1922, page 202.
3. "Candlenut and Chinese Wood Oil Trees", by W.N. Sands.—*Malayan Agricultural Journal*, Vol. XII, 1924, page 1.

4. "Oil from Aleurites Trisperma", by C.D.V. Georgi,—*Malayan Agricultural Journal,* Vol. XIV, 1926, page 290.
5. "Oil from Aleurites Species," by C.D.V. Georgi,—*Malayan Agricultural Journal,* Vol. XIV, 1926, page 290.
6. "Preliminary Report on the Cultivation of Candlenut at Serdang", by T. D. Marsh,—*Malayan Agricultural Journal,* Vol. XVI, 1928, page 212.
7. "Oil from Aleurites Montana", by C. D. V. Georgi, and Gunn Lay Teik,—*Malayan Agricultural Journal,* Vol. XVI, 1928 page 296.
8. "Preliminary Report on the Cultivation of Aleurites Montana", by J. N. Milsum and T. D. Marsh,—*Malayan Agricultural Journal,* Vol. XVII, 1929, page 47.

Acknowledgement.

The writer wishes to make due acknowledgement for the information extracted from the memorandum prepared by the Imperial Institute entitled "The Production of Tung Oil in the Empire", published by the Empire Marketing Board, and to the various Departmental publications mentioned above.

TYPES OF MALAYAN COPRA*

BY

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The quality of copra varies considerably for different districts. On the rough " F.M." and " F.M.S." sorting basis the following comparative and approximate figures for the "mixed " copra were derived from a few selected districts :—

TABLE 1.

Quality of Copra from different districts.

Lowest grade :—	Imported (A)	100 per cent.	F.M.
	East Coast (A) West Coast (A) Imported (B) East Coast (B)	60—80 per cent.	F.M.
	Imported (C)	50 per cent.	F.M.
	West Coast (B) West Coast (C) West Coast (D)	20 per cent.	F.M.
Highest grade :—	West Coast (E)	10—15 per cent.	F.M.

(The letters refer to the place of production.)

The quality of copra from all districts suffers to some exent from the picking of young nuts while in two West Coast districts this fault is particularly marked.

Unless physical properties are taken into consideration, the analyses of samples taken from bulked copra (See Table 2) can be very misleading since the moisture is generally erroneous because the small sample received has usually dried in transit; the oil percentage (or either extract, dry basis) of bad copra may be as high as 74 per cent. or as low as 60 per cent. according to the ripeness of the nuts, the degree and manner of deterioration by moulds and insects, losses by burning and the extent of free acid reduction by ventilation; while the acidity varies with the moisture percentage and the time and conditions of storage of the copra.

More significant analytical results are, however, obtained after copra has been

* The following is the concluding part of a paper read at the Second Inter-Departmental Agricultural Conference, Kuala Lumpur, F.M.S., on October 30th, 1930. The first two parts were published as follows :—The Economic Aspects of Copra Research. *Mal. Agr. Journ.* February 1931, and Factors of Quality in Copra, *Mal. Agr. Journ.,* March 1931.

sorted on the basis of appearance. A complete comparison of almost every selected quality available on the market is given in Table 3. The results were obtained by an analysis of 5 lb. samples, the free acidity being determined on the expressed oil; while the thickness of the copra was obtained by taking the average of a number of pieces of each type. In the case of insect-ridden copra, this rough comparison was obtained by weighing similar slices.

The results shew definitely that careful nut collection and copra preparation are rewarded by the highest oil and copra yields. It must again be pointed out that incorrect picking, faulty preparation and all subsequent deterioration is paid for by the Malayan producers. Even though they contribute their share of work in helping the material on its way to the manufacturer, the middlemen are merely percentage takers and the price they are able to pay is a more or less accurate reflection of the ultimate quality of the product.

If the dealers were to receive a well-dried and well-prepared product from all sources within Malaya they would not need to resort to redrying. Furthermore, the deterioration in shipment would be so greatly reduced that they could safely offer a better price.

TABLE 2.

Chemical Analysis of Bulk Samples of Native Copra.

District.	Oil Percentage (dry basis)	Acidity Percentage.
West Coast (C)	* 67.2	.5
	64.3	.9
	64.8	.7
Imported (B)	* 67.6	1.5
	* 68.6	1.4
	* 68.2	2.5
Imported (D)	* 68.4	.9
	64.1	.2
	* 66.0	3.0
Imported (A)	64.7	2.3
	* 66.6	1.6
	* 67.8	3.4
West Coast (A)	* 68.2	1.7
	* 68.7	1.1
	65.8	1.7
East Coast (A)	* 68.0	1.9
	64.3	2.2
	* 67.8	3.1
Average—Native Copra ...	* 67.0	1.7
Compare Average—Estate Copra ...	65.6	.1

* Note high oil percentage and high acidity.

Nut Harvesting.

The chief problem that has been studied during the past year is the development of meat and oil within the nut during ripening and the advantages of storing nuts for one month previous to drying as is the usual practice in Ceylon. It is hoped to produce a special report on this subject shortly when the work is completed.

The general indications are: firstly, that fully ripe brown nuts containing an haustorium about 1 inch in diameter will give the highest total oil and copra yields; secondly, that the meat of green unripe nuts contains about 60 per cent. moisture, while ripe nuts yield wet meat containing between 40 and 50 per cent.; and thirdly, that there is no advantage in storing nuts, either ripe or unripe, for one month before extracting and drying the copra, except that the contained meat becomes firmer and drier.

Drying and Storage.

Apart from considerations of oil and copra yield, the indiscriminate collection of very under-ripe and over-ripe nuts together with ripe brown nuts and the subsequent drying together of meat containing different degrees of moisture must result in an irregularly dried product. Some pieces will be over-dried, burnt and yellow, while the pieces of under-ripe meat will still be wet and in storage will become slimy and mouldy and will make the remainder wet.

Little investigation has yet been carried out in Malaya regarding copra drying beyond an examination of the performance of different types of driers in use in the country. It seems that the drying of copra has been speeded up at the expense of quality of the product and as a result examples of "case-hardening", "caramelisation" and "black-burning" are quite common. Whereas the period for kiln-drying in Ceylon is between 5 and 7 days, in Malaya 4 days is the maximum, while as little as 24 hours drying has been recorded in several instances. For native production, 48 hours is approximately the standard period, while estate production usually involves 72 hours drying. It must not be thought that accelerated drying must be ruled out entirely, but the correct conditions essential for the production of satisfactory copra have yet to be ascertained. Great heat applied to the product at the wrong time, local overheating, absence of air movement in certain parts of the mass being dried, combined in some cases with the deposition of soot and tarry volatiles owing to bad firing, all contribute to produce an unsatisfactory product.

Possible Oil Loss.

While it has been proved in the Philippines *and confirmed in Malaya that ordinary coconut oil does not lose weight if it is heated at 100°C for three days, results to date lead to a strong suspicion that the oil yield (by the ether extract

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* *Phil. Journal of Science* March 1917. "Copra and Coconut Oil" Brill, Parker and Yates.

TABLE 3.

Types of Malayan Copra.

Type of Copra.	Acidity Percentage.	Oil Percentage (dry basis)	Oil Percentage (as received)	Estimated thickness of copra Mms.	Estimated Efficiency Yield per nut. Oil	Copra
Perfect Sundried ...	.1	65.4	62.1	9.0	100	100
Typical F. M. S. Copra ...	.33	65.6	61.9	9.0		
Wrinkled } Copra from unripe nuts ...	.63	60.0	55.2	5.0	51	56
Leathery }	1.6	59.1	55.0	5.3	54	59
Thin Copra from overripe nuts ...	5.01	74.2	70.7	4.5	60	52
Burnt Black ...	.70	69.0	65.7	8.0	97	90
Burnt ...	.34	64.9	60.3	8.5	94	96
Caramelised and slight insect attack ...	.24	64.8	61.5	8.5	66	96
Burnt and heavy insect attack ...	1.50	60.1	56.9	7.0*	74	80
Very severe insect attack ...	1.60	64.8	61.5	6.0*	68	66
Slimey, black and rancid ...	5.01	73.7	68.8	7.5	80	72
Heavily, black moulded ...	5.25	68.3	64.3	8.5	92	88

*Estimated by comparative weights of similar slices.

method) of the copra prepared from the same wet meat under different conditions can show serious differences. The explanation of this anomaly, if conclusively proved, is not obvious and investigation of the problem is still proceeding.

Case-Hardening :—A number of samples of copra produced by accelerated drying have been examined and the structure of these samples has been found to be a hard smooth skin covering a wet core. This structure makes subsequent re-drying by storage, which is a regular commercial practice, an unprofitable proceeding because, while the moisture from the main bulk of the copra is lost only very slowly, insect attack and mould growth with acid formation are able to proceed freely whenever the crust is broken.

For sampling, the copra was sliced tangentially into four slices parallel to the testa or brown skin.

TABLE 4.

Moisture Gradient in Copra.

Sample	Moisture percentage.			
	Slice A (Inside face)	Slice B (Interior)	Slice C	D (Testa)
1. Immediately after rapid drying ...	8.2	16.7	—	—
2. Native copra, glossy caramelised skin, after long storage	4.7	8.1		
3. Sundried for 3 days. ...	11.6	7.1	5.3	7.6
4. Typical wet undried coconut meat (for comparison) ...	80.0	50.0	35.0	15.0

The first two examples in Table 4 are of "case-hardened" copra, whilst sample 3 illustrates uniform drying. It will be seen that each slice of sample 3 has been dried seven fold, whereas in the case of sample 1 slice A has dried ten fold and the wet core, slice B has only dried three fold.

The bad effect of the redrying by storage has already been referred to while the uselessness of such a proceeding for case-hardened copra was shown by an analysis of such copra, before and after two week's storage in bulk.

TABLE 5.

Effect of Storing Copra with a Wet Core.

Case-hardened copra.	Average moisture percentage.	Average acidity percentage.
Sample (1) as above, before storage ...	8.2	.04
Sample (2) the same after 14 days storage for further drying	7.7	1.36

The difficulties of the manufacturer in dealing with a "case-hardened" copra have previously been mentioned.

Under-drying. Insufficient kiln-drying caused by deliberately curtailing the drying period, or by the copra having been too thickly piled on the drying platform, raises a very serious situation for all the native producers concerned. In one district, the price of wet copra of excellent appearance is only $4 per picul. A deadlock has been reached, because the producer receives no incentive to improve his product; the general tendency is therefore to include as much water as possible. Organised selling could probably right this situation and bring about a better understanding between buyer and seller and so ensure a better product and a better cash return.

Conclusion.

Considerable stress has been laid on the bad points of Straits Copra and on native-produced copra in particular. While no guarantee can be given that the adoption of some of the above recommendations will result in an added financial return, it must be emphasised that as increasing supplies of edible oil of all kinds become available and as the increased plantings of coconuts during and just after the war is resulting in ever-increasing world yields of coconut oil, a position may ultimately be reached when the market will become so seriously discriminating and competitive that bad copra will be unsaleable at a profit. Should the general quality of Malayan copra meanwhile be advanced to make it an outstandingly good product and nut collection be organised to obtain the maximum yields, the position of this country will then be considerably strengthened.

It has been shown that the system of marketing is as much the concern of the producer as of the trader, for the losses resulting from bad methods are his losses. Until it is recognised that lack of organisation, particularly among native growers, leaves them entirely in the hands of the middlemen and effectively prevents the all-round production of really dry, good quality copra which will maintain both quality and quantity in storage, the standard of Malayan copra will continue to be low and the best return will not be obtained. The individual grower, working alone on a small scale cannot successfully market his product to the best advantage to himself except in very special cases and market conditions do not encourage him to take extra trouble and to produce only copra of first-class quality.

The following recommendations are submitted:—

(1) As far as possible, nuts should, as in Ceylon, be allowed to fall naturally.

(2) If the nuts are picked, only fully ripe brown nuts should be harvested. Nuts slightly germinating, with about a 1 inch haustorium give the highest oil and copra yield.

(3) Where fallen nuts only are collected and the labour of picking is saved, collecting tours can be more frequent.

(4) Drying should not be hastened unduly, or unduly curtailed; burning should be avoided and uniform drying assured by free air movement through the copra and by uniform nut collection.

(5) Drying should proceed until the copra contains 6 per cent. of moisture.

(6) Clean, freshly prepared copra should be placed in clean, close woven bags immediately after drying which should be closed to prevent the ingress of insects.

(7) The bags of copra should be stored in clean, dry, rain-proof stores which allow free air movement around each bag.

(8) The possibilities of baling either by a power operated machine at a central receiving depot, or otherwise by a manual machine should be explored further, chiefly because baled copra is considerably less bulky than copra in sacks and so freight is saved.

(9) Producers, particularly native producers, should consider co-operative marketing, so that a better grade of copra may be marketed. An improved price for native copra of good quality and the avoidance of copra loss will result in improved financial returns to these producers.

Errata. Paragraph 1 line 3 of the previous article "Factors of Quality in Copra" in the March issue of the *Malayan Agricultural Journal* should be amended to read as follows:—

..... "If these conditions are satisfied, the copra will generally arrive in Europe insect and mould free, white and sweet unless the consignment is exposed to insect infestation 'en route' or is rewetted."

SOME OBSERVATIONS ON CHARACTERISTICS AND TREATMENT OF PADI SOILS *

BY

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In this paper it is proposed to give a summary of recent work on a few selected problems; many others such as soil atmosphere, soil flora and nutrient requirements will be omitted.

The Soils of Rice Growing Countries and their Relation to Yield.

It has proved difficult to get a clear picture of the rice soils of other countries, even of soils on which experimental work has been carried out. Many writers content themselves with the statement that experiments were conducted at "X" station, others describe soils by a class name which may have only local significance and quite frequently writers differ widely as to the characteristics of what they describe as typical rice soils of a given country.

There is still more uncertainty as to the degree of care which has been exercised, when assigning yields, to secure reliable figures which have not been vitiated by extraneous factors such as pests or water supply.

Taking the figures for what they may be worth we find for physical characters the following:—

Philippines (*Riz and Riziculture Vol. I*) the most usual soil is said to be sand 20 per cent., clay 45 per cent., humus 35 per cent. This would, of course, give an extremely open textured soil *if* the remarkably high humus figure is correct.

Java. From internal evidence in Wulff's compilation (to be discussed later) Java soils appear to show a minority of stiff clays or silts.

Burma. Warth (*Chem: Memoirs Dept. Agric. India V. p. 131*) who carried out pot experiments with a large number of Burma soils, unfortunately gives no physical analyses but relies on "soluble silica" as an index of texture. This is unfortunate as degree of laterisation will affect the relationship—from his figures there would appear to be a very extensive range from very stiff to very sandy soils.

The most ambitious attempt at comparison of soils emanates from Ceylon—"Contributions to the study of the paddy soils of Ceylon and E. Countries" Bruce, *Department of Agriculture Ceylon Bulletin 57 '22.*

Samples were collected from S. India, Ceylon, Burma, Malaya, Philippines, Siam and Japan by workers in those countries and were analysed in Ceylon. In

* Paper read at the Second Inter-Departmental Agricultural Conference, Kuala Lumpur, F.M.S., on October 28th. 1930.

order to allow for changes in methods of expressing analyses, the results given by Bruce for Malaya are included in the following summary of his work:—

Physical characters. (Bruce)

Malaya. Malayan soils contain from 27 per cent. fine sand, (Titi Serong) to 46 per cent. fine sand at Klebang Ketchil (Malacca). Fine fractions are approximately 40 per cent. clay +fine silt and 20 per cent. coarse silt (all analyses are, of course, on the old method). "Humus" is low, being 2.9 per cent. for Titi Serong. Yields vary from 1,500 lbs. per acre in the Ulu Muar district (=290 gantangs approx.) to 2,500 lbs. per acre in Malacca and 2,400 lbs. per acre (=460 gantangs per acre) in Titi Serong.

Ceylon. Soils from the S. E. Province of Ceylon (Galle and Matara districts) contain 5—12 per cent. of humus, high clay, low fine sand (only 9 per cent.) but about 12—20 per cent. coarse sand and gravel. Those from the remainder of the Island have low fine fractions silt + clay 8—35 per cent. and high coarse sand and gravel (30—70 per cent.) with low humus. All planting is broadcast; there is a small amount of manuring in some districts and irrigation is widespread. Yields in the S. E. Province are, on two of the soils examined, 500—700 lbs. per acre and in one 3,000-4,500 lbs. per acre; while on the others (sandy soils) they are 675-1,000; 900 and 1,440 lbs. per acre respectively.

S. India. Three soils were examined, all show low humus, 27—40 per cent. clay and fine silt, 22—36 per cent. fine sand and 20—30 per cent. coarse sand +fine gravel—transplanting is practised and in some cases cattle manure is applied—irrigation is practised. Yields are 1,800-2,600 lbs per acre.

Burma. Five soils were examined humus is low (1.8-3.1 per cent.), clay and fine silt high (50—70 per cent.), fine sand low (9—15 per cent.) and coarser sand is absent. Yields are all approximately 2,000 lbs. per acre. There is no irrigation.

Philippines. Two soils. Humus low (1-2.5 per cent.) (contrast figure on.p. 173) clay and fine silt 20—33 per cent.; fine sand 20 per cent. and coarse sand and fine gravel 40-50 per cent. Transplanting and irrigation are practised, manuring is not, and yields are 1,500-1,900 lbs. per acre. The low figure for humus is difficult to reconcile with the very high one given above.

Siam. Three soils. Humus is not given but from loss on ignition it may be expected to be moderate, clay and fine silt 60—65 per cent.; fine sand 3—12 per cent.; no coarse fractions. Neither transplanting, manuring nor irrigation; yields are 960-2,400 lbs. per acre.

Japan. Four soils. Humus moderate 2.5-5.6 per cent., clay and fine silt 17-38 per cent., fine sand 20-42 per cent. and coarse sand 16-24 per cent.; in one case gravel 19 per cent. Transplanting, manure and irrigation are employed and yields are 1,700-3,500 lbs. per acre.

Chemical Characters.

(Bruce) These are somewhat confusing—as usual the figures for pH lose most of their value as the method of determination is

* 1 gantang is taken as weighing approximately 5.2 lbs.

not given—for what they are worth our soils are stated to be 'sour' pH 4.7—5.5 : Japan comes next 6.5—7.2--Ceylon 5.7—8.3, Philippines 7.5; Siam is not given and S. India and Burma 8.2—8.7.

Nitrogen is in general 0.10 per cent. to 0.25 per cent. with very low figures for S. India of .05—.08 per cent.

Lime in Ceylon, Malaya, Siam and part of Japan is 0.1—0.5 per cent. while in S. India, Burma, Philippines it is 0.6—2.0 per cent.

Magnesia varies in a similar manner.

Potash is very low 0.1 per cent. in Siam and in some of the Ceylon soils, moderate 0.3—0.7 per cent. in Malaya, the remaining Ceylon soils, Philippines and Japan, and high in S. India and Burma.

Phosphoric Acid (P_2O_5) Total phosphorus is lowest in Siam 0.04—0.07 per cent. and from 0.08—0.25 per cent. in the remainder, no regular variation being found.

Available phosphoric acid is lowest in Malaya and Siam (0.004 per cent.) averaging 0.015 per cent. in the others; no great regularity is shown.

Analyses from other sources.

Siam. Detailed analyses of Siam soils are given by Ladell (*Technical Station Supplement to Record No. 6, 1930*) and agree with Bruce's figures. Ladell records instances of rapid fall in yield, in one case amounting to 50 per cent. of the original in 5 years. He attributes this to accumulation of soluble salts and acidity owing to poor drainage. His pH in suspension varies from 3.75 to 4.53 and shows no correlation with yield; he finds his water extracts all to be 6.5 pH.

Burma. Warth, mentioned above, deals in considerable detail with Burma soils, unfortunately without stating yields. Many of his total P_2O_5 figures are as low as 0.01 per cent.—but he extracted with unheated acid which renders comparison doubtful.

Hendry (v. inf.) who also deals with Burma soils and gives the country average yield as 1,500 lbs. per acre points out that, contrary to general belief, the better padi lands of Burma receive no annual silt deposit, being above flood level. He can trace no decline in fertility since 1872, the first year of reliable records. He considers this to be due to the fact that break-down to soluble nutrients now equals uptake by the crop.

Malayan soils. Most of our own analytical work has been on physical analysis—and I am deeply indebted to the Field Officers who collected the large number of samples required. With each soil was sent an estimate of yield; this naturally is only an approximation, but is unlikely to err by being too high. Taking the figures for what they are worth and excluding all samples in which an explanation other than that of soil was given for low yields or in which the analyses showed considerable differences between top and subsoil, we have the results set out in Table A. Naturally, these distribution tables must not be taken as representative of the relative *extent* of each class in Malaya, since no account is taken of the extent of any particular area. We find no correlation between mechanical composition and yield and further find, assuming yield of figures and sampling

to be even approximately correct, that soils light in texture compared with those of the chief rice-growing districts are capable of providing quite useful yields.

This confirms the deductions to be drawn from the analyses given above for other countries, and suggests that given accessibility and an adequate water supply, caution should be exercised in condemning a soil on the ground that it is not heavy.

TABLE A.

Sand Percentage.

0—20	21—40	41—60	61—80	Total.	Gantangs per acre.
3	1	1	1	6	0—80
5	9	7	4	25	81—180
20	26	24	15	85	181—280
17	19	24	9	69	281—380
15	20	15	3	53	381—480
6	4	4	1	15	481 upwards
Total 66	79	75	33	253	

Figures represent numbers of soils in each class.

Chemical analysis reveals nothing of special interest, and yield could not be correlated in any way with figures for nitrogen, ammonia, or phosphorus (total or available).

The soils are all acid in suspension varying from 4.2 to 5.8 pH. Acidity in clear extracts in very much less and does not confirm Ladell's theory of acid accumulation. Nitrogen varies from 0.1 per cent. to 0.6 per cent. and P_2O_5 from 0.04 per cent. to 0.17 per cent.

Manuring.

Manures may be divided into artificials, animal and green; or mixtures of these. Taking artificials first we have:—

Nitrogen. There is general agreement that nitrates are without effect or

are even deleterious to wet padi, although in the Philippines they have been found to be beneficial to dry padi. The explanation is usually sought in denitrification under anaerobic conditions, formation of nitrites, and rapid leaching. The popular view that rice can absorb nitrogen only as ammonium salts appears to be unfounded (v. inf.)

Nitrogen in artificial fertilisers is usually applied in the form of ammonium sulphate (or latterly one of the ammonium phosphates) and in general in conjunction with phosphatic fertilisers. In only a few instances have nitrogenous fertilisers alone in controlled experiments given considerable increases.

Potash. Potash has not, in general, been found necessary in tropical rice growing countries.

Phosphorus. The majority of recorded increases of any magnitude have followed the application of phosphatic manures alone or in conjunction with nitrogenous manures. In general, superphosphate or one of the ammonium phosphates has been employed; unit for unit, little difference has been found between the newer and older fertilisers.

Results in Different Countries.

Malaya. Routine applications of fertilisers in Malaya are strictly limited, the exceptions being in Kedah where considerable quantities of naturally occurring phosphates are said to be regularly employed and in Malacca where ground bones have been employed for many years; the results in the former case are said to be of great benefit, but no definite figures are available. As far as experimental work is concerned, fertilisers in Malaya have nowhere shown a great increase in yield. Even after making a number of unjustifiable assumptions in the working out of the results of experiments carried out over a term of years at Talang and Malacca, we find no significant increases at the latter, and only barely significant ones at the former Station—wherever increases of any kind occurred, phosphatic manures were concerned and at Talang the (theoretically) slow acting Perlis phosphates appeared to be, over a term of years, as efficient as the quicker acting artificials. In the few experiments which have been made with ammonium phosphates there are indications of considerable yield increases.

These experimental results form a curious contrast with those recorded in other countries where increases of yield of 70-100 per cent. are not uncommon and where ammonium phosphates have exhibited no signs of specific action. It is impossible to say how far the apparent success of trials in other countries is due to a tendency to stress successes and to minimise failures, but it is a fact that one recent paper devotes several pages to a successful experiment and dismisses two unsuccessful ones in two lines! Another frequent fault is the expression of yield increase as a percentage without giving actual figures; it is clearly most important that the datum line from which an increase occurred should be known.

Siam. The only recorded experiment* is with Leunaphos (ammonium phosphate) in which the smallest application used produced an increase over the unmanured control of 41 per cent. of grain and of straw; further increases of manure increased the straw to 64 and 69 per cent. but left grain increase unchanged.

Java. The best record of manurial experiments on tropically grown rice is to be found in Wulff's article in *Landbouw I* page 25 No. 2.

A few typical results will be quoted:— On Bantam Tuffloam, super and ammonium sulphate raised a yield of 730 lbs. per acre (say 140 gantangs) to 2,760 (say 530 gantangs). With fairly high controls on such soils (1,420 lbs. per acre) the increase was to a similar figure, i.e. the percentage increase was much less. On brown weathered laterite in Batavia no manure gave any increase on 4,700 lbs. per acre (900 gantangs per acre).

On a marl loam in Begogan there was clear evidence of the beneficial action of nitrogen in combination with phosphorus although the latter alone gave no increase over the control of 3,200 lbs. per acre (610 gantangs per acre) The nitrogen was here applied in 4 parts, at ½, 1, 1½ and 2 months after transplanting.

On brown marl loam there were divergences, no increase being recorded at Semarang over 1,950 lbs. per acre (375 gantangs per acre) with any form of manure, while at Grobogan a control of 3,300 lbs. per acre (640 gantangs per acre) was unaffected by nitrogen; raised to 4,900 (940 gantangs) by phosphorus or nitrogen and phosphorus and to 5,800 (1100 gantangs per acre) by a complete mixture: one of the few instances in which potash has done good.

In the Pate district on "gesek" soil (sandy and powdery when dry) a control of 700 lbs. per acre (135 gantangs) was raised by phosphorus to 1,350 (260 gantangs and by nitrogen, and phosphorus to 2,200 lbs per acre (420 gantangs per acre).

On clays results varied e.g. on a black clay at Madioen a control of 2,400 lbs. per acre (460 gantangs per acre) was raised to 3,000 lbs (575 gantangs.) by nitrogen and unaffected by phosphorus. At Ponorogo with a control of 3,000 lbs. there was no increase with any manure, while a similar soil in the same district with a control of 1,600 (310 gantangs) showed an increase to 2,600 (500 gantangs per acre) with phosphorus, other manures having no effect.

Wulff very frequently found that the maximum effect of nitrogen was obtained by application in two or more doses after the plants were transplanted ("overbemesting"). Although he does not say so, this seems to imply very complete water control.

Very interesting figures for nursery manuring are given, using manures in the nurseries at a rate four times that of field manuring (since the area of the nursery is 1/4 that of the field) it was found that in the Bantam district on tuff loams in one case no increase was produced, in another a control of 1,700 lbs. (325 gantangs) was raised to 2,100 (400 gantangs.) by superphosphate.

In a complex experiment on marl loam the following results were obtained:

* At the time of writing this paper.

No manure nursery	No manure	Field	1250 lbs. p.a	(240 gantangs)
No „ „	phosphatic	„	3100 „	(595 „)
Phosphates „ „	No manure	„	2650 „	(510 „)
Phosphates „ „	phosphatic	„	3500 „	(670 „)

Similar results were obtained on a heavy clay with a control of 2,600 lbs. (= 500 gantangs).

These Java results have been quoted at some length, not with a view to direct application, but to show that :—

(a) even on soils chemically far richer than those in Malaya, large responses can be obtained;

(b) in a series of carefully recorded experiments numerous failures to secure response occur;

(c) no one manurial mixture will suit all soils;

(d) initial high yield is no bar to response.

Japan. In Japan, where yields have risen from 310 gantangs in 1885 to 525 in 1920, nitrogen rather than phosphorus or potash is found necessary.

The Japanese workers claim that lime is only useful if the magnesia content of the soil is high.

Burma. A good account of manuring in Burma has been given by Hendry in *Agric. Journ. India* XXIII p. 357 '28 and XXV p. 126 '30. At Hmawbi, experiments ran for 10 years, 5 years with manuring and 5 years without. The soil is obviously heavy as it is noted that green manures cannot be grown owing to the cement-like nature of the ground when dry. In the first paper, actual figures are not given—change being expressed merely as percentages.

Results obtained were.

		5 years manuring percentage change.	*5 years residual effect percentage.*
Cattle manure +30—70 lbs. N	...	40—70	21—31
Cotton cake	...	53	54
Bone meal	} 20 lbs. P_2O_5	26	9
Superphosphate	} 20 lbs. P_2O_5	35	15
Pot. sulphate	...	0	6
Sod. nitrate	...	17	35
Cyananide	...	11	64
Ammon. sulphate	...	24	25
Lime	...	24	2
Complete	...	33	17

Like all workers in India, Hendry is careful to translate these results in terms of money, an excellent idea which should be more widely followed. As an example, ammonium sulphate at pre-war prices with a 25-30 per cent. increase would have meant a loss of 5.5 Rs. per acre and in 1928 a gain of 2 Rs.

Experiments with ammophos (control = 240 gantangs), illustrate this point further—using 20 :20 Hendry found 50 lbs. fertiliser gave an increased yield

of 48 per cent. an increased profit of 15 Rs. per acre.

100 lbs fertiliser gave increased yield of 68 per cent. 19 Rs. per acre increased profit.
200 „ „ „ 103 11 „
500 „ „ „ 119 24 „

Later experiments showed the following.

Manure	*Yields = lbs/ac.*	*G/ac.*	*Percentage Increase*	*Profit Rs.*	*Increase A.*
Control ...	1066	205	—	—	—
Diammophos ...	2098	405	97	15	7
Ammophos ...	2112	410	98	14	12
Super am. sulph. ...	2112	410	98	11	6

These results are of particular interest to Malaya as the new synthetic manures show no special manurial virtues; they also show the considerable increases required to produce good monetary return.

Hendry also makes the good point that the native cultivator must have quick returns especially when he has bought his manures with money borrowed at a high rate of interest.

Results in Ceylon, as far as available, vary with the soil type and need not be considered in detail.

Animal Manure.

The only countries in which manure of this description is extensively employed appear to be China and Cochin China. The Chinese are said to have rather a curious system of rotting down rice straw by making it into a compost with mud from the canal banks; the mixture is afterwards spread on the fields.

Green Manures.

There are singularly few descriptions of experiments on modern lines with green manures; in an article in the *Agric. Jour. of India 18 p.* 104,1923 the following results are given :— Control 1065 lbs. per acre (205 gantangs) green manure also or with a small quanity of apatite (mineral phosphate) gave no significant increase; green manure+740 lbs. apatite gave a rise to 1,400 lbs.; superphosphate or basic slag gave 1,500 to 2,100 lbs. The soils were poor and sandy. The Italians claim that green manures favour the action of phosphorus. Other workers in India stress the view that green manure is more effective on sandy than on heavy rice soils.

For manures, *Sesbania aculeata* is recommended in Ceylon while *Calotropis gigantea* is a favourite in Cochin China where, as in Japan and parts on India, the intensive collection of extraneous green matter is carried out.

Recent work by Joachim and Kandiah in Ceylon (*Trop. Agric. 72* p. 254) reviewed in the *Malayan Agricultural Journal* (Jan. 1930) gives considerable data on the decomposition of green matter in dry and wet padi soils both in the laboratory and in the field. Unfortunately, yield results were somewhat

spoilt by floods; in one case, taking the control as 100, early application of green manure gave an increase of 16 per cent. and late application of 30 per cent. The authors appear to be influenced throughout by the view that nitrates are deleterious to padi, a view in turn based on the very numerous observations of previous workers that sodium nitrate had frequently no manurial value and was often deleterious while sulphate of ammonia increased yields. This fact has been, until recently, ascribed to conversion to harmful nitrites (more than 5 parts per million of nitrite having been found to be harmful), to loss as gaseous nitrogen, to leaching and to inability of rice to assimilate nitrates. It was observed that application of sodium nitrate was frequently productive of chlorosis. Gericke as a result of his recent water culture work (v.inf) has give what seems the most probable explanation, which is that the residual alkali after removal of the nitrate radicle inactivates iron, and as rice has a great need of iron but can only very slowly assimilate it, chlorosis follows. This theory is confirmed by an observation of Willis recorded in *Jour. Agric. Research 24* p.621 25 to the effect that calcium nitrate did not cause chlorosis. Clearly if Gericke's view is correct, nitrates produced by nitrification should not be deleterious to padi although nitrification may be undesirable because of subsequent loss due to leaching.

The authors confirmed previous observations that only traces of nitrate and nitrite were present, but found considerable increases in ammonia—typical results for mbrs N as NH_3 percentages were :—

	Before puddling.				*After puddling.*					
Time in weeks	2	4	6	7	1	3	5	7	9	13
Control	2	2.1	3.0	3.23	1.22	1.73	1.31	1.05	.91	.73
Green manure late					2.69	4.79	4.30	1.87	1.69	.87
Green „ early	3.4	3.7	5.2	5.8	1.85	2.13	2.13	1.36	1.16	.83

Weeds gave results very similar to the green manures and total nitrogen figures were :—

	Initial N per cent.	*Final N per cent.*
Control ...	.1895	.1791
Green manure early ...	.1971	.1801
Green manure late ...	.1885	.1939

They further claim that in pot experiments with green manures, appreciable quantities of gases were given off after the second week from soil to which green matter had been added, but not from the controls and that the scum on the surface said by the Indian workers to be responsible for aeration had increased. They therefore claim better aeration for the padi roots. This claim must remain questionable until the evolved gases have been analysed; if they are poor in oxygen (which is highly probable) it is difficult to see, even with increased algal action, how aeration beneath the surface can be increased, as the tendency should be to sweep oxygen out and upwards.

Work in our soils laboratory on rice soil atmosphere has been started and these points will be tested. While the balance of evidence is in favour of the conclusion drawn by Joachim viz. that green matter should be turned in late,

further work is needed both in the laboratory and field before definite advice can be given.

Lord in his review of manurial results (*Trop. Agric. 73* '29) finds that the effect of green manuring varies with soil, in one case there was distinct evidence that a green manure was necessary for the action of artificials to be manifested.

The practice of "Rab" cultivation (described in the *Chemical Memoirs Dept. of Agric. India* II p. 180) in W. India is of interest. In this the top layer of soil from seed beds is mixed *in situ* with cowdung and leaves and burned before sowing, giving increased fertility of 150 per cent. The action has been attributed to flocculation, but gypsum which also flocculates, gives an average of only 25 per cent. The analogy to the beneficial effect found by Russell to result from moderate heating of temperate soils is suggestive. This beneficial effect is generally attributed to reduction in numbers of protozoa with a consequent increase in numbers of beneficient bacteria, which are prayed on by protozoa.

Field experiments showed that a seed bed burned with—

Cowdung rab	will plant	2.4	times	the area of	untreated.
Branches	„ „	2.1	„	„	
Grass	„ „	1.1	„	„	
Cowdung alone	„	1.3	„	„	

Drainage.

Perhaps the most perplexing feature of rice literature is the insistence on the need for "drainage", which appears to be somewhat loosely used for (a) the changing of irrigation water and (b) drainage in the usual sense of water movement downwards; most writers making drainage a *sine qua non* for the successful growth of the rice plant on the grounds that otherwise harmful acids will accumulate and/or the roots will lack necessary aeration.

There are many padi fields in Malaya in which there is little circulation of irrigation water and the majority (in area) can exhibit remarkably little subsoil drainage; further in the case of padi fields which are never really dry, conditions may be expected to be always definitely anaerobic. Yet these fields produce year after year very reasonable yields of padi. Clearly further work on drainage, soil atmosphere and soil flora is indicated.

The Work of Gericke on Water Cultures.

Perhaps the most interesting piece of research in connection with rice in recent years has been that of Gericke of which a brief resumé follows :—

Gericke has been studying for some years the combination of salts giving best growth in water cultures, the time in the life history of the plant at which absorption of any particular element occurs, and the effect on growth of the absence of certain elements. His most recent paper (*Soil Science 29* '30) deals with rice. The method is one worked out by him in which the plants are grown for a definite period in a complete solution, then transferred to a solution lacking one so called "essential" element. In favourable cases he obtained plants as

large, heavy and healthy as those in a high yielding field, but failed to obtain with rice correspondingly large grain crops. The failure is attributed by him to pollination difficulties. He found that potash, nitrogen and iron are required for a much longer period than the other elements, in fact almost throughout life, but that calcium, magnesium, sulphur and phosphorus do not seem to be needed after initial exposures of 4—6 weeks; from this he draws the conclusion that the former are the essential elements for rice. It is equally possible to argue that since the elements of the second group must be or are normally absorbed in a very short space of time they must be presented to the plant in an available form in considerable quantities or conversely that as the absorption of the first group is spread over a long period they can be more readily foraged for.

It must be realised that these experiments, conducted as they are in water culture, may not give a true picture of happenings in the soil—this work is, however, suggestive in the light of Wulff's nursery manuring experiments.

It is interesting to note that Espino working in the Philippines with water cultures (*Phil. Journ. Science 16* p.460 '20) claims to have found that a very high relative proportion of magnesium is necessary for successful growth. This, if confirmed, would be most important in Malaya on our (generally) magnesium poor soils. The point is being tested in the new standardised padi experiments.

Padi Roots.

Although not strictly a soil problem, a recent paper by Sethi in *Memoirs Dept. Agric. India Bot. Series 18* No. 2 '30 is of interest. He claims as the result of studies in pot culture and in the field—

(i) That two types of roots can be observed (a) thin, brown flaccid branched roots (b) bold, white, almost unbranched.

(ii) That root system becomes weak and flaccid at flowering.

(iii) That root development shows distinguishing diagnostic characters for each variety which could be of help in the selection of varieties suited to particular localities.

(vi) The texture of clay seems to suit root development better than that of other types of soil.

(v) Anatomical observations confirm various views that rice is not strictly an aquatic plant, but that aeration is absolutely essential.

The importance of (iii) is self-evident and it is suggested that work on local varieties might be of considerable importance.

Conclusions.

Soils. It has been shown that padi is commercially grown on a large variety of soils and that *given water* there seems no reason to suppose that many areas in Malaya could not be profitably employed which normally are considered to be on the light side. The point is being tested on the padi tanks at the Experimental Plantation, Serdang.

Manures. The results quoted show that increases are not invariably to be obtained even on the same soil type; so far, no satisfactory explanation is forthcoming of many of the differences of response observed.

It is urged that the monetary return be always given a prominent place in the records of trials, and that a large margin of safety be established before recommendations are made to the rayat.

The effect of especially careful cultivation of Test and Demonstration Plots should be considered. It is urged that the final tests or demonstrations should always be made with the standard of cultivation current in the District. If it is desirable that the standard of cultivation be raised, it is suggested that this should be the subject of a separate campaign.

The questions of nursery manuring, the application of nitrogen by instalments*, green manuring, the use of cheap naturally occurring but slow acting manures and the use of basic or neutral instead of potentially or actually acid manures on Malayan soils require study.

* A publication just received from Indo-China (*Bull. Econ. de l'Indo-Chine* 33 4B) shows that the application of nitrogen by instalments is practised there.

Extracts.

PREVENTION AND TREATMENT OF STEM-ROT OF OIL PALMS

BY

A. THOMPSON.

Acting Mycologist.

The following article is extracted from a Special Bulletin entitled "Stem-rot of the Oil Palm in Malaya" by Mr. Thompson, which is now in the press. The importance of the information contained therein and the need for its early dissemination, accounts for the publication of this extract.

Prevention.

Since it is considered that the sources of infection are to be found in the jungle stumps and fallen timber left after the jungle is felled previous to planting, it is desirable that such timber should be removed as soon as possible. The cost of doing this is the main consideration. Cleared land, however, possesses advantages which might be offset against the original cost. Drainage, and cultivation if necessary, are more easily accomplished; weeding costs are reduced and harvesting and transport are accelerated. Furthermore, the danger of white ant damage is much less. It is, perhaps, premature to advocate such a policy, but up to the present no signs of stem-rot disease have appeared on any of the oil palms growing on the Government Experimental Plantation, Serdang where the land was cleared of all timber before planting. Some of these palms are now eight years old. If the timber is not cleared, it is advisable to inspect it for fungus fructifications, and to destroy any which are producing frutifications of the fungi mentioned above.*

It is difficult to clear timber from peaty land and there is always a risk of a serious fire if the timber is burnt without careful supervision.

It is advisable to clear before the palms grow too big, since the expense will be greater if the palm leaves have to be tied back and shielded when burning the piled timber.

Protection of the freshly cut tissue of the leaf bases after pruning is the next consideration. It has already been mentioned that, when pruning, the next growing leaf is usually wounded by the pruning instrument. Consequently, any protective covering applied to the cut surface of a leaf base should also be applied to the wounds on the leaf above. It is customary on estates to use either an axe or a "parang" (a heavy knife with a blade about two inches wide and over a foot

* Species of *Fomes* and *Ganoderma.*

in length) as the pruning instrument. While these instruments are preferred by the labourers and are said to be more efficient for use in harvesting on tall palms, the writer advises the use of a broad-bladed chisel and mallet for pruning the lower leaves of young palms not yet in bearing. These lower leaves are very difficult to prune without wounding the other leaves and under these circumstances a chisel and mallet are easier to handle than an axe or parang.

Numerous preparations have been tried as protective coverings for freshly cut tissue. The properties required in a cover are durability and cheapness. The water-miscible preparations such as Agrisol and Izal, were not found suitable, since they are easily washed away by rain. Furthermore, it was found that freshly cut palm tissue may develop gaping cracks a few days after pruning and also following the application of disinfectants, including those non-miscible with water, such as Solignum, Brunolinum and Dougalite. Coal tar had a similar effect, and a locally produced wood-tar which had the merit of cheapness, had a rather vigorous action on the tissue and did not appear to give a permanent cover. Various anti-corrosive paints, and certain chemical compounds e.g. Basilith, were also rejected either through not giving a lasting cover or on account of expense. Trials with Asphalt (D.X.) mixed with various oils gave promising results, and what appears to be a suitable covering has now been obtained.

If the mixture is sufficiently thick it forms an elastic and waterproof covering. Leaf bases treated with a mixture of Asphalt approximately 65 per cent. and Kerosene 35 per cent. were examined after eight months and it was found that the covering was unaltered. The mixture had penetrated only very slightly into the tissue which was sound.

Another mixture which has given good results is Asphalt 65 per cent. and Solar Oil 35 per cent. (approx). The latter mixture is cheaper at present prices, and costs about 33 cents per gallon as compared with Asphalt and Kerosene oil mixture which costs about 46 cents per gallon.

The late Mr. H. Sutcliffe of the Rubber Research Institute of Malaya carried out tests of similar mixtures, and stated that they are suitable for wound treatment on rubber trees * He gives the following formulae for treatment of Pink Disease * :—

(1)	Asphalt (D.X.)	40 lbs.
	Kerosene oil	3 gallons
	Brunolinum	40 ounces.
	Cost =	53.1 cents per gallon.
(2)	Asphalt (D.X.)	40 lbs.
	Solar oil	4 gallons
	Brunolinum	40 ounces.
	Cost =	35.4 cents per gallon.

* Sutcliffe H. The use of Asphalt and Bitumens on Estates". *Quart. Journ. Rub. Res. Inst. Malaya* Vol. 2., No. 3., November 1930.

The cost of the treatment on oil palms is not easy to estimate since the cost of labour must be considered in addition to the cost of the materials and the number of leaves which would be pruned per palm per acre. On one young estate is was found that 1 gallon of the Asphalt and Kerosene mixture was sufficient to treat the freshly pruned leaf bases of 27 palms from each of which about 18-20 leaves had been removed. During normal harvesting between 8 and 12 leaves are removed per palm per annum so that as a rough estimate 1 gallon of mixture should be sufficient to treat somewhat less than 1 acre of palms per year, reckoning 55 palms to an acre. If the figure for labour is not included, the cost of the treatment on palms in bearing would be about 40 cents per acre per annum if the Asphalt and Solar oil mixture is used. With regard to labour costs, the extra time required to carry out the treatment properly should not delay the pruning labourers very much once the work is organised.

The covering should be applied as soon after pruning as possible, especially in wet weather when *Thielaviopsis* is active.

The labourers should be instructed to apply the cover only to clean white tissue. Any decayed spots exposed by pruning should, if possible, be removed by pruning lower. Any wounds in the leaf above, or splits in the side of a leaf base, should also be covered.

During very wet weather, when rain falls heavily in the afternoons, it is advisable to see whether the covering has been damaged before it has had time to set. It would be advisable in the wet seasons to add a small amount of Brunolinum, Solignum or Dougalite to the protective cover, if heavy and continual rain is experienced.

Treatment.

It is possible to treat diseased palms successfully, but the work must be done thoroughly as otherwise re-treatment will probably be necessary. The work is costly, but if a large percentage of palms are found to be diseased, many of them can be saved if the disease is discovered in an early stage.

Since there are no very obvious signs that a palm is diseased until the rot is too far advanced for treatment, it is difficult to determine whether a palm needs treatment. Coolies experienced in the work can often find infected palms by striking the old leaf bases during a round of inspection. A healthy leaf base gives a firm hard sound when tapped, while a diseased leaf base gives a dull hollow sound, and can sometimes be pulled away from the stem. Suspected cases should be examined, and if the rot in the leaf base resembles the typical rot, the stem should also be examined. In some cases the stem will be found to be sound, but in others the tissues may be rotted to varying depths. If the stem is cut and found to be healthy, the cut should be covered with a little Asphalt, Oil and Brunolinum mixture, to prevent subsequent infection.

If the stem is found to be diseased, further inspection will reveal whether treatment is possible or the disease is in too far advanced a stage. Sometimes the disease attacks only one side of a palm, and sometimes it is found on both

sides. Palms have been treated when the stem was half rotted through on one side and after a year have been found to be still sound. The treatment of such advanced cases, however, is not recommended because it is probable that, when the palms grow taller, the weight of the crown will cause the stem to crack at the point of treatment, if much of the stem tissue has been cut away. Badly infected palms should be cut down, cut into pieces and burnt, or buried, and a trench should be dug around the "grave" in case trouble should later arise in the roots of adjoining palms. This is at present considered to be unlikely. The writer favours burying as opposed to burning, since it is difficult to burn diseased tissue, and fructifications of *F. pachyphloeus* (?), and *G. lucidum* have been found in profusion on a half burnt stem, a few months after it was burnt. The spores from these fructifications may cause infection in neighbouring palms and should not be allowed to form.

If the disease is in an early stage, further extension of the rot can be prevented by excising the rotted tissue until only healthy, white tissue is left. A protective covering should be applied. Asphalt and Oil mixture has given satisfactory results as a cover, but it must be applied thickly. The inner palm stem tissue, if exposed, does not harden or form new tissue, thereby differing from woody trees like rubber trees. Consequently, an artificial "bark" must be provided, if the leaf bases are entirely removed. In nature, an oil palm will form a hard stem, since defoliation is natural though slow, and even when artificially pruned, either the leaf bases harden and persist for a long time if not diseased, or they slowly disappear leaving a hard rough stem.

A covering which flakes off, or which causes cracking of the inner stem tissues, is not much good. Asphalt and Oil mixtures, however, are remarkably persistent if thickly applied and if allowed to "set" before being damaged by rain.

In wet weather it is advisable to add Brunolinum or a similar product to the mixture, on account of the danger from *Thielaviopsis* mould.

The treatment adopted when the disease first appeared, was excision of diseased tissue followed by painting with 25 per cent. solution of Agrisol or 3-5 per cent. solution of Izal. The palms were left for a week until the stem tissue had dried somewhat, and the tissue was then covered with Coal Tar. It was found, however, that further cracking occurred, and a second coat of tar was required. Also, in wet weather, *Thielaviopsis* mould attacked the tissue within twenty-four hours if heavy rain fell, and the tar did not give a good cover.

A certain amount of bleeding sometimes occurs at the edges of the Asphalt cover and the sap may flow down over the cover in streaks, which turn yellow. *Thielaviopsis* sometimes grows on this sap, but the mycelium does not penetrate through the cover, and has not been noticed to penetrate at the edge. It is, however, advisable to apply the Asphalt cover well beyond the edges of the exposed tissue.

If treatment cannot be supervised, the coolies are liable to leave spots of disease in the stem tissue, especially if they are given a "task" in a bad area.

Treatment is expensive, if much diseased tissue has to be cut away, and there is always the possibility that a fresh infection may start later above or below the treated patch.

It would perhaps be preferable to cut back all the leaf bases on a treated palm until clean leaf base or stem tissue is exposed and covered with the mixture, but the cost of doing this is excessive, owing to the labour involved.

It is not possible to give final recommendations as to the advisability of treating palms now in bearing until further information is available. At present, the price of palm oil is low and the margin of profit is not great. Treatment of diseased palms is possible but is expensive. On one estate a large number of diseased palms have been saved by treatment, but it is as yet not known whether the younger estates are likely to be affected by the disease to the same extent. Preventive measures can, however, be employed and are not unduly expensive if adopted on the younger properties not yet in bearing.

CATTLE FEED FROM RUBBER SEEDS *

Experiments have been carried out for several years in different parts of the world on the extraction of oil from rubber seeds and the use of the cake for feeding cattle. Lately a new industry has grown up in the United States of America where the high cost of linseed has caused manfacturers to look round for cheaper raw materials for the oil and oil-cake industry and the use of rubber seeds may be favoured by the low price level of rubber and related products.

In the organ for the American Department of Commerce, "Commercial Reports" this question was recently given prominence and a considerable amount of information given regarding the utility of rubber seeds which cannot fail to be of much interest to a country like Denmark which is a large consumer of oil cakes.

The seeds which have been utilized for the manufacture of oil and cakes are collected from rubber estates in the Dutch Indies and British Malaya. The production is calculated to be about 500,000 tons per year of which 300,000 tons are produced in the last named country, the balance in Java and Sumatra. The use of the seeds in the American oil industry is still in its infancy, as only 3,500 tons were exported this year, but it is expected that the export next year will exceed 10,000 tons.†

The seeds are treated in hydraulic presses and yield about 44 per cent. of oil and 50 per cent. of oil cake or meal while the loss is usually 6 per cent. The oil is utilized in the manufacture of soap, linoleum and paints. The oil shows on analysis to have practically the same composition as the oil from soya beans. The seeds are collected twice a year, usually in February and August.

The Effect on the Production of Milk.

The Polytecnical Institute of Virginia, together with the State Agricultural Experimental Station have completed a series of investigations on the value of the cakes of rubber seed for feeding cattle. These Institutes have stated that the cake must be considered a new valuable cattle food, rich in albumin and with a pleasant smell somewhat similar to cocoa cakes. It contains usually 30 to 34 per cent. albumin, 40 to 44 per cent. carbohydrates and 4 to 6 per cent. fatty substances.

The effect on milch cows with regard to their producing capacity has also been examined. The results show that the production of milk increased 10 per cent. when rubber seed cake was used for feeding instead of linseed cake. The content of fatty substances in the milk was also increased.

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* The following is a translation of an article by H. Hansen, Divisional Manager, Teluk Merbau Estate, Sepang, Selangor which was published in the Danish daily newspaper *Berligske Tidende* of 3rd October, 1930.

† The Company responsible for exporting rubber seed from Malaya for this purpose has now ceased operations. The export of seed is now negligible.

It should be understood that the production figures given above refer to the estimated yield of seed. Much of this seed, however, would be too costly to collect and market. (*Ed. M. A. J.*)

Reviews.

Guide to the Government Experimental Plantation, Serdang.

Department of Agriculture, S.S. and F.M.S. 139 pp, Index, 12 plates, 5 plans. Price $2/- post free (Straits Settlements Currency). 1931.

The Staff of the Agricultural Division of the Department of Agriculture, S.S. and F.M.S. are the authors of this Guide to the Government Experimental Plantation, Serdang, Selangor.

The Plantation was inaugurated ten years ago. During this period its development has been steady and its work has become widely known and appreciated not only in Malaya, but also in other parts of the world.

The increasing number of visitors to the Plantation has made it desirable to publish a guide which will give a summarised review of the different lines of progress of the principal activities of the station.

The Guide contains a review of 165 crops that have been investigated, in addition to more detailed accounts of the factories and machinery and the stock farm.

The arrangement of the book into eighteen sections, the variation in type for names of crops and the provision of an adequate index renders it possible for the reader to refer to any subject without delay.

The volume will therefore be of particular assistance to visitors to the Plantation, but should also be a very useful book of reference for planters. While it is difficult to select any one section as meriting special mention, the reviewer is particularly impressed with sections 13 and 14 which deal with fodder grasses, and cover crops and green manures, respectively, in the compass of nineteen pages.

The references enable the visitor to the Plantation to locate any crop he desires to see, while throughout the book are frequent references to publications of the Department which will enable the reader to amplify the information available concerning any subject treated in the Guide.

The book contains an account of a vast amount of useful work, the full scope of which can only be adequately grasped when it is viewed as a whole; together with valuable information concerning many existing and possible new crops.

It is understood that although the Guide is not one of the Special Bulletins of the Department, a copy will be sent to every annual subscriber to the Special Bulletins of the Department of Agriculture.

D. H. G.

Farm and Industrial Tractors.

BY

D. N. Mc. Hardy.

Crossley Lockwood and Sons, London, 1930.

This book, which contains 16 chapters and 234 pages, describes the wide range of uses to which tractor power can be put and should assist the owner and driver to get the best out of the tractor under their charge. The book is written, as far as possible, in non-technical language and is well illustrated, it can therefore be easily understood with little or no previous experience.

The first two chapters of the book deal with the early development of the tractor and the results of tractor trials carried out in Great Britain. The first application of mechanical power to direct traction on the land was steam and several types of steam tractors have been designed, but their greatest drawback was weight per horse power. Later, the internal combustion engine-tractor was designed, but although they only came into prominence during the period of the Great War as a result of the abnormal conditions prevailing, pioneer designers had been at work for many years previously. The demand for their products had not, however, been great enough to bring them into prominence. War time needs brought hosts of tractors to the fore, but some were of very imperfect design. The early designs were too heavy and at the Highland and Agricultural Society's trials in 1917 it was found that the light tractor provided with spuds on the wheels gripped the ground and performed its work better than the heavy machine. Great improvements in design and efficiency took place between the time of the Lincoln trials in 1919 and the Shrewsbury trials in 1922. Nearly all the machines exhibited at the latter show weighed less than 40 cwts. The Committee's opinion at the Shrewsbury trials was that a minimum of 25 B.H.P. was desirable for a general purposes tractor on the farm.

Having dealt with the early history and trials the next ten chapters are devoted to the internal combustion engine, giving details of construction and the working of the various parts. Valve operation, fuels and carburation, ignition, lubrication, cooling systems, transmission systems, chassis design and running gear are all dealt with and are adequately illustrated.

The crude oil engine tractor is described and its advantages and disadvantages are discussed. Hitherto, the chief advantage of this type of tractor has been its great weight per horse power, but this has been largely overcome. It also costs more to manufacture than the normal petrol or kerosine oil tractor engine and has not yet been proved sufficient by mature experience. The advantages of this type of engine are that no magneto, sparking plugs, or carburettor are necessary, these being replaced by automatic fuel pumps. For light loads the fuel admitted is reduced and for heavy loads is increased, the result being an engine which is nearly as flexible as a steam engine. It is economical in fuel consumption, using

less per break horse power than petrol or paraffin engines, and in addition, the fuel is much cheaper.

Chapter XII is devoted to the driving of the tractor and the next two chapters deal with the maintenance and possible sources of trouble.

The organisation of farm work, ploughing, tillage, drilling seeds, haying and harvesting, belt work, farm haulage and the costs of these operations are all dealt with in separate chapters. The last five chapters are devoted to horticultural tractors, industrial types, trailers and equipment and some industrial uses to which tractors can be put. Specifications of leading makers of tractors on the British market are contained in an appendix.

The book is well illustrated and indexed and should prove useful to tractor owners and drivers generally.

J. L.

The following Ceylon Sessional Papers have recently come to our notice and may be of interest to agriculturists in Malaya.

Annual Report of the Board of the Tea Research Institute of Ceylon for 1928—Sessional Paper VI—1929, price 10 cents. Report of the Board of the Tea Research Institute of Celon for 1929—Sessional Paper VII—1930, price 10 cents. Report by the Economic Botanist on a visit to Malaya, Indo-China, Sumatra and Java, March—May, 1929—Sessional Paper XXXVII 1929, price Re, 1.15.

These may be purchased from the Government Record Office, Colombo at the above-stated prices.

Miscellaneous Articles.

ENTOMOLOGICAL NOTES.

First Quarter, 1931.

The introductions of parasitic or predaceous enemies from one country to another to control the same or a related species of insect have increased considerably during recent years and the advisability or otherwise of introducing one or more enemies of a pest, since one parasite may reduce the efficiency of another, has received attention amongst entomological workers in the biological control of insects.

In a paper on "The Insect Pests of Coconuts" which was presented to the Delegates to the Inter-Departmental Agricultural Conference in October, 1930, the writer stated that the Tachinid, *Chaetexorista javana* B.B., would not appear to be such an important enemy of *Parasa lepida* as of *Setora nitens* and mentioned that the Braconid, *Apanteles parasae* Rohw., was a more evident parasite of the caterpillars of *Parasa lepida*. The predominance of *Apanteles parasae* over *Chaetexorista javana* appears to be due to the development of the former at the expense of the latter as the following observations illustrate. The writer in March collected from the nipah palm, three caterpillars of *Parasa lepida*, on the ventral surface of which *Chaetexorista javana* had deposited numerous eggs. An examination showed that most of the eggs had hatched and the presence of several maggots of *C. javana* within the caterpillars. One of these caterpillars was dissected when abount 50 grubs of the Braconid, *Apanteles parasae*, were also found. Grubs emerging from the other two caterpillars spun their whitish coloured cocoons from which *Apanteles parasae*, in one case 26, emerged.

The above illustrates super and multiple parasitism and would appear to suggest that the introduction of *Apanteles parasae* for the control of *Parasa lepida* or a related Limacodid should only be considered.

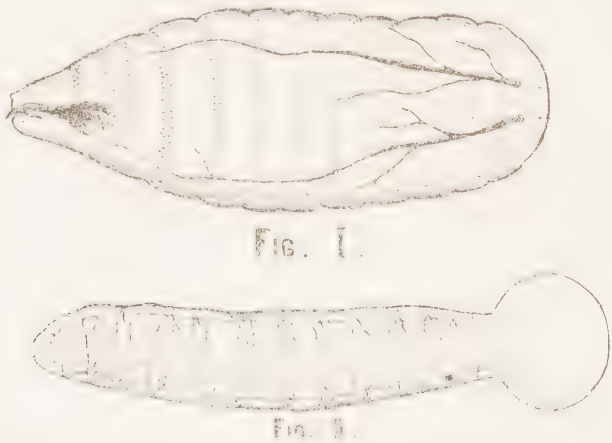

Fig. I. Maggot of *Chaetexorista javana* B.B., Fig. II. Grub of *Apanteles parasae* Rohw.

Both larvae dissected from the same caterpillar of *Parasa lepida*.

Seasonal Occurrence of Insects.

Several reports of outbreaks of insects have been received and observations extending over some years indicate that numerous insects in Malaya are prone to increase to large numbers towards the end and the beginning of the year.

The prevalence of some insects at certain times of the year would not appear to be connected with a quiescent period but largely to the adverse influence of climatic conditions on the controlling parasites.

The more important reports were as follows :—

Cephonodes hylas L.—the Coffee Hawk Moth—may be collected from coffee and *Gardenia* throughout the year but for some years between January to March it has been reported causing extensive defoliation of coffee plants. This year it has been prevalent on coffee areas in Selangor and if regular inspections of areas were made during the beginning of the year and, on the appearance of this moth, control measures immediately instituted, much damage could be prevented. Towards the end of an outbreak a parasite, which parasitises the eggs of the hawk moth, is common and undoubtedly is the responsible factor for terminating outbreaks.

Four leaf-eating caterpillar pests of coconuts, viz :—*Hidari irava* (The coconut skipper), *Mahasena corbetti* (The "Case-worm"), *Setora nitens* (a nettle caterpillar) and *Amathusia phidippus* (The two-horned caterpillar), have been reported, all more than once.

The habit of *Tiracola plagiata* migrating from secondary growth to cultivated areas, generally rubber and tapioca, has previously been observed on numerous occasions. A report of its migration from secondary growth to young rubber was received during February.

Valanga nigricornis—the large greenish yellow coloured short horned grasshopper— several times during the quarter has been recorded injuring rubber.

Mimosa (*Mimosa pudica*) is probably the chief host of the Lymantriid caterpillar, *Orgyia turbata*. This insect is frequently prevalent towards the end and the beginning of the year. The appearance and habits of this insect were described in 1927* soon after its habit of migration to rubber had been recorded. The female of this moth is wingless and therefore its spread is due to the caterpillar. This may be prevented by spraying with lead arsenate a strip around the attacked area, thus forming a poison barrier.

With the exception of *Valanga nigricornis*, adults of which may be collected at any time, the above named insects pass through several generations during the year and heavy rains, occurring from about September to the end of November, would appear to be responsible for destroying their parasites, thereby allowing these pests to multiply without restriction.

The Cicadid—*Dundubia vaginata F.*—which causes so much annoyance by entering bungalows at night during February and March has a yearly life cycle

* *Malayan Agricultural Journal*, Volume 15, pages 240—255.

and its appearance, as the insects enumerated above, is not influenced by climatic conditions.

Copra.

The inferior appearance of copra is due in part to the attacks of insects and if more care were exercised a considerable amount of damage could undoubtedly be prevented.

Badly damaged copra was found on two occasions to be due entirely to the employment of old rice sacks containing a variety of insects. If such sacks are used they should receive careful attention and before filling with copra should be rendered insect-free.

Miscellaneous.

The bindings and leaves of books are often damaged by insects, especially the beetle, *Lasioderma serricorne* F. Books in cases fitted with wire gauze keep better than in closed book cases.

A mixture in general use for the preservation of books is composed of the following substances :—

Corrosive sublimate	1 oz.
Carbolic acid	1 oz.
Methylated spirits	1 quart.

This mixture is applied from time to time to the binding of books by means of a fine brush.

G. H. C.

HALF YEARLY REPORT ON COPRA RESEARCH WORK FOR THE PERIOD ENDING 31st DECEMBER, 1930.

BY

F. C. Cooke,

Assistant Chemist for Copra Research.

Nut Harvesting and Fruit Storage. Large scale experiments have been conducted on six estates to determine the correct time to harvest nuts so as to obtain the highest oil and copra yield per nut. It has been found that the highest yield is obtained when nuts are ripe and brown, and commencing to fall naturally, and contain an "apple" of about 1 inch diameter.

There does not appear to be much advantage in storing nuts previous to drying.

Copra Drying. Small scale experiments have shown that the percentage oil content as determined by ether extraction declines when coconut meat is dried under a variety of conditions although no volatiles appear to be evolved. Grated copra, in particular, very readily turns yellow and shows a markedly decreased oil content. This has been demonstrated both on an industrial scale and in the laboratory. Further work is in progress.

A design has been prepared for an experimental kiln of the Ceylon type to be installed at the Klang Experimental Station.

Coconut Charcoal. Renewed inquiries from England and the improved price now offered for this by-product has resulted in a further review of the situation with a view to its export.

Insects and Moulds. Heavily insect ridden copra from eleven world sources have been examined. After the copra was brushed clean of all adherent fibrous dust, the residual copra in most cases showed a normal oil content. The loss of dry copra was estimated to amount to half the original weight.

In conjunction with the Mycological Division, work on the study of copra moulds is proceeding and several pure cultures have been prepared.

Copra Baling. Further consignments of baled copra have been examined and the results have again shown that this method of packing neither causes oil loss nor exceptional formation of free fatty acids.

Copra of the lowest grade was also baled and after storage for 14 days in Malaya in open formation in a stack was ready for shipment to Europe, the moisture content having become reduced to the normal for exported copra.

Co-operation. The Peasant Produce Marketing Committee, which has been formed recently, is giving special attention to copra.

Agricultural Shows. A comparison of different types of inferior copra with high grade "F.M.S." copra has been the chief feature of the exhibits at five local

shows. Coconut products and correct nut harvesting were also demonstrated.

Ceylon Copra. A large number of Ceylon seed nuts have been examined and the results have shown that the Ceylon nuts as received here contain less but more oily meat than do typical Malayan coconuts. From information received, however, the Ceylon palms yield more of these small nuts per palm.

Copra Research Laboratory. Special accommodation has been provided and the new laboratory is now in running order.

Articles. Published in the *Malayan Agricultural Journal* :—"Coconut on Peat", "World's Coconut Crop". Abstract :—"Marketing Problems of Coconut Growers". Paper for Conference :—"The present day position of Copra Research and the practical application of the results".

Copra and Oil Palm Research Committee. The Assistant Chemist for Copra Research is acting as Secretary to this Committee and two meetings have been held in the past half year.

Departmental.

FROM THE DISTRICTS.

The Weather.

The weather throughout the month continued to be hot and dry with occasional showers in some districts, more especially towards the end of the month.

Remarks on Crops.

Rubber.—The local prices given for rubber from small holdings remained about the same as in February, being $10—16 for smoked sheet and $8—13 for unsmoked sheet.

Wintering continued, but was less uniform than that experienced in 1930. In some localities the new flush of young leaves was making good growth towards the close of the month.

The prevailing dry conditions exercised a noticeable check on the prevalence of Mouldy Rot disease and this fact, together with the enforcement of control measures, has caused a marked improvement in all badly infected areas.

Oidium Leaf Mildew was definitely reported to be present only in the District of Port Dickson in the Negri Sembilan. Up to the present it would appear to be much less prevalent than it was in 1930.

Padi.—Harvesting for the season 1930—31 was nearing completion in most parts of the country. It was noticed in Malacca that the crop was remarkable for the number of empty grains and reports were common that padi not attacked by any pest had yielded only half the crop normally obtained. It is feared that the crop in the Dindings will be almost entirely destroyed by draught.

Local prices for padi have ranged between 5 and 7 cents a gantang in most districts, except in the Negri Sembilan where they have varied from 8 to 12 cents and in parts of Perak South where they have also been as high as 12 cents a gantang.

Measurements of yields from trial plots of pedigree strains have been continued. In Kuala Lipis District of Pahang these strains gave yields varying from 400 to 760 gantangs per acre as compared with 320 to 480 gantangs per acre for local varieties. Pedigree strains also gave good results in Raub District of Pahang and in parts of Perak South where, for example, strain R 4 yielded 400 gantangs per acre as compared with 200—250 gantangs per acre from local varieties.

In Temerloh District of Pahang most of the nurseries were sown, but if the existing drought were to continue, it was feared that replanting would become necessary.

Efforts to popularise the pedigree strains of padi continue. In the Negri Sembilan the Padi Inspectors have attended the local weekly fairs with samples and have booked orders for seed. Other orders have been received as a result

of the Rural Lecture Caravan in parts of Seremban and Tampin Districts. A, demonstration was given on the Bukit Merah Padi Test Plot in Province Wellesley. This was attended by some 60 Malay padi planters and headmen who evinced keen interest in the work in progress.

The Padi Fly, *Leptocorisa* sp. occurred in large numbers in parts of the Central District of Malacca.

Coconuts.—The yield of coconuts in Perak South is reported to have fallen considerably, possibly owing to the draught in 1930. In Province Wellesley South a few seedling palms were attacked by the two coloured Coconut Leaf Beetle, *Plesispa reichii*. Control measures were undertaken.

Food Crops.—Large areas of land are being cleared in Temerloh District of Pahang for further planting with such food crops as Maize and Tapioca. The Malays living on the banks of the Pahang river undoubtedly realise the necessity and value of supplementing the very uncertain wet padi crop each year.

Fruit.—Heavy crops of guavas and limes were harvested in Lower Perak District, but prices were low, the former being sold at 3 or 4 fruits for one cent and the latter at 12—15 cents per 100. In Upper Perak District, durian, mangosteen, macham and other fruit trees were flowering.

Coffee.—In Batang Padang District of Perak a ready market in the town of Tapah for the locally grown Liberian and Robusta coffee has encouraged Malays to plant more of this crop where land is available. Local prices are 28 cents a kati for Liberian and 20 cents a kati for Robusta coffee. These compare favourably with prices in other parts of the country, for example 16 cents a kati in Temerloh District of Pahang. In the Dindings an outbreak of caterpillars of the Coffee Hawk moth, *Cephonodes hylas* on ten acres of coffee was successfully controlled by hand picking.

Tobacco.—A consignment of tobacco grown by a number of Chinese gardeners at Sungei Rambei in Province Wellesley and weighing just over 16 piculs was sold in Penang during the month for the encouraging price of $48 per picul. With a continuance of this price, gardeners are likely to extend the cultivation of this crop. Most of them have recently evinced a desire to try an experiment in planting the Deli type of tobacco, which, they claim, loses less weight in drying than does the Kedah type which they are now growing. In Perak South some Malay and Chinese cultivators are planting up this crop for the first time, while others are extending the areas previously planted. The types grown are mainly Javanese and Chinese. The price obtained for the dry leaves is about 30 cents a kati.

Notes on Demonstration Stations

Pulau Gadong Padi Experiment Station, Malacca. During the month a pumping plant, consisting of a 3 B.H.P. Petter engine and a 4 inch by 3 inch Worthington Pump, was installed at this Station. The running of this plant is satisfactory and the output of water sufficient for complete irrigation of the whole Station.

Agricultural Exhibition, Malacca.

A collection of exhibits of local agricultural produce was staged in Malacca for the benefit of passengers on three tourists ships which arrived there during the first week of the month. The crops illustrated were rubber, padi, coconuts, oil palm, tapioca, tea, local fruits in season and local vegetables. The exhibition was well received and appreciated by the visitors among whom were a proportion of teachers and of business men interested in tropical produce.

School Gardens.

Work in these gardens was recommenced when the schools re-opened after the holiday for the fasting month and the padi harvest. Operations consisted chiefly of the cultivation and remaking of the beds in preparation for replanting.

Rat Destruction.

In Province Wellesley 225,232 and in Malacca 60,949 rats tails were collected during the month, the great majority being from very young animals dug out of the bunds in the padi fields where nests are numerous now that the main breeding season has commenced. In Temerloh District of Pahang, lectures on rat destruction were given in two mosques. Malay leaflets and supplies of barium carbonate were distributed in order to stimulate interest in rat control at a time when the padi nurseries are being sown.

DEPARTMENTAL NOTES.

Visit of H. E. The Governor-General of the Philippines.

His Excellency the Governor-General of the Philippines, accompanied by the American Consul-General for Malaya, the Secretary for Agriculture for the Philippines, the Secretary for Commerce and other members of the Philippine adminstration paid a visit to Kuala Lumpur on March 16th. His Excellency visited Sungei Way Estate during the morning.

In the afternoon Mr. Rafael Aluman, Secretary for Agriculture and Natural Reserves, Philippine Islands, Mr. Lester Mayrard, United States Consul-General Singapore and party visited Serdang Plantation and were conducted round the Station by the Director of Agriculture S.S. and F.M.S. and the Agriculturist.

The Director of Agriculture Visits Singapore.

The Director of Agriculture visited Singapore from March 8th. to 11th.

The Oil Palm Factory at Serdang.

The installation of the additional new machinery in the oil palm factory at the Government Experimental Plantation, Serdang, is now completed and will permit of useful and interesting comparisons being made between the centrifugal and press systems of palm oil extraction.

The installation of the Stork hydraulic press was completed in February. The press is now working satisfactorily.

The Laval Separator, which has been erected for the purification of palm oil, was also put in working order in February and as a result, a much cleaner sample of palm oil is now being produced.

It is hoped shortly to publish in this Journal a full account of the palm oil factory erected on the Plantation.

Rural Lecture Caravan.

The new propaganda caravan, organised by the Department of Agriculture, the Co-operative Department and the Rubber Research Institute of Malaya made its first visit to Negri Sembilan in March, visiting parts of the Seremban and Tampin Districts. The tour was a conspicuous success, the lectures and demonstrations attracting large crowds on each occasion. A full account of the caravan and of the work it is doing will be included in the next number of this Journal.

Demonstration at Serdang.

On 20th. March a party of Chinese attended a Demonstration at the Government Experimental Plantation, Serdang, being conducted round the Plantation by the Chinese Sub-Inspector of Agriculture.

As the members of the party were mainly interested in tea, the visit was almost exclusively devoted to the management of this crop and the manufacture of tea.

On this occasion special attention was directed to the area under Guinea grass, as trials have indicated its suitability as a food in fish rearing.

The party expressed appreciation of the visit. One Chinese gentleman expressed a desire to spend more time on the Plantation and was invited to make up a party of interested agriculturists from his district for the purpose of a further visit.

Staff Change.

Mr. H. J. Simpson took over the duties of Agricultural Field Officer, Perak South, from Mr. E. A. Curtler on 1st. March, 1931.

Leave.

Major C. D. V. Georgi, O.B.E. Acting Agricultural Chemist, returned from leave of absence on 12th. March, 1931.

Mr. T. D. Marsh, Assistant Agriculturist, returned from leave of absence on 19th. March, 1931.

Mr. E. A. Curtler, Assistant Agriculturist has been granted 8 months leave on full pay, with effect from 6th. March, 1931.

Statistical.

MARKET PRICES.

Rubber.—In spite of the slight rise in the price of rubber early in the month, the end of the month saw the commodity still weaker, the lowest price on record, 10¾ cents per lb. being offered on the Singapore market on the last two days of the month. The average price for the month was 12 cents per lb. Singapore, compared with 11.9 cents for February. The average London price was 3.8d. as in February: the highest price quoted being 4 1/8d. on 5th, the lowest 3 3/8 on 29th. and 30th. March.

Palm Oil.—London writing under date of 19th. February states that the market continues to decline steadily and the value on that date was not more than £14 per ton F.O.B. on a basis of 18 per cent. F.F.A.

Copra.—Owing to a temporary shortage of supplies, the price of copra in Singapore advanced during the first half of the month. Later the market tended to decline as supplies came in more freely. Average prices were: Sundried, $5.97 per picul; Mixed, $5.58 per picul, compared with $5.67 and $5.33 respectively in February. Copra cake has been quoted at $1.50 to $1.60 per picul, the average price being $1.58.

Pineapples.—The following are the average prices paid in Singapore per case of canned pineapples: 1½ lb. cubes, $3.28; 1½ lb. sliced flat, $3.14; 1½ lb. sliced tall, $3.42. A good deal of business was done early in the month for delivery April/May/June at very low prices. Later the market was quiet but steady with moderate business passing for forward delivery.

Tapioca.—The Singapore market has been quiet but steady. Average prices per picul for the month were: Flake, fair, $4.20; Pearl, seed, $5.25; Pearl, medium, $6.00 compared with $4.07, $5.06 and $6 per picul in February.

Sago.—Singapore average prices for March were: Pearl, small, fair, $5.75, Flour, Sarawak, fair, $2.44 per picul compared with $6.06 and $2.48 per picul in February.

Rice.—Local prices shew a further sharp decline during the month. The following are the average monthly prices in dollars per coyan during the present year.

	January	February	March
Siam No. 2	186	175	165
Saigon No. 1	176	161	154
Rangoon No. 1	156	148	139

Gambier.—Market remains featureless. Block gambier is quoted at a nominal price of $9.75 per picul while Cube No. 1 averaged $15.00 per picul in March.

Pepper.—There has been a certain amount of speculative buying on the Singapore market, but generally the market has been dull and easier. Average Singapore prices per picul for March were: Singapore Black, $21.00; White,

$38.50; Muntok White, $39.75. The February average prices were, respectively, $21.06; $36.88; $38.12.

Cloves.—Average Singapore prices in March remain unchanged at Zanzibar, $62 per picul; Amboina, $59 per picul.

Nutmegs.—Average prices in Singapore for the month were for 110 per lb., $23.37 per picul; 80 per lb., $27.75 per picul. Corresponding prices in February were $25 and $29.75 per picul.

Mace.—Average Singapore prices: Siouw, $79.75 per picul against $92.50 in February; Amboina, $59.50 per picul against $59.50 per picul in February.

The above prices are based on London and Singapore quotations for rubber; on the Singapore Chamber of Commerce Reports for March, and on other local sources of information. Palm Oil Reports are kindly supplied by Messrs. Lewis and Peat (Singapore) Ltd.

1 picul = 133 1/3 lbs. ... 1 coyan = 40 piculs.

The dollar is fixed at two shillings and four pence.

NOTE. The Department of Agriculture will be pleased to assist planters in finding a market for agricultural products. Similar assistance is also offered by the Malayan Information Agency, 57 Charing Cross, London, S.W.1.

MALAYA RUBBER STATISTICS

TABLE I

STOCKS, PRODUCTION, IMPORTS AND EXPORTS OF RUBBER, INCLUDING LATEX, CONCENTRATED LATEX AND REVERTEX, FOR THE MONTH OF FEBRUARY, 1931, IN DRY TONS.

Territory	Stocks at beginning of month 1			Production by Estates of 100 acres and over		Production by Estates of less than 100 acres (estimated) 2		Imports				Exports (including re-exports)				Stocks at end of month		
								during the month		during the year 1931		during the month		during the year 1931				
	Ports	Dealers	Estates of 100 acres and over	During the month	during the year 1931	during the month	during the year 1931	Foreign	From Malay States	Foreign	From Malay States	Foreign	Local	Foreign	Local	Dealers	Estates of 100 acres and over	Ports
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
MALAY STATES :—																		
Federated Malay States	...	12,877	15,369	11,383	23,651	9,282	19,311	Nil	5	Nil	9	12,406	6,365	26,420	14,062	15,016	15,129	...
Johore	...	2,257	4,801	3,320	7,061	4,062	8,291	Nil	2	Nil	2	605	6,818	1,234	13,947	2,307	4,712	...
Kedah		463	2,671	1,957	4,453	1,031	2,400	Nil	Nil	Nil	Nil	565	2,787	1,266	5,866	364	2,406	...
Perlis	...	10	10	7	15	11	27	Nil	Nil	Nil	Nil	Nil	24	Nil	49	5	9	...
Kelantan ...	...	188	101	202	397	422	882	5	Nil	7	Nil	54	558	109	1,082	224	82	...
Trengganu ...	...	55	50	101	153	50	76	Nil	Nil	Nil	Nil	Nil	151	Nil	229	55	50	...
Total Malay States		15,850	23,002	16,970	35,730	14,858	30,987	5	7	7	11	13,630	16,703	29,029	35,235	17,971	22,388	...
STRAITS SETTLEMENTS																		
Malacca ...	...	3,365	1,664	1,118	2,330	(2) 2,000	(2) 4,000	Nil	16,696	Nil	35,224	5,260	Nil	10,439	Nil	3,518	1,658	...
Province Wellesley		133	663	414	924			Nil		Nil						118	564	...
Dindings ...		167	128	95	200			Nil		Nil		6,903		12,541		152	125	...
Penang	1,364	5,244	14	7	19			763		1,609						5,047	10	1,877
Singapore ...	4,740	33,293	299	175	368			7,194		15,337		16,158		31,521		34,151	311	3,301
Total Straits Settlements	6,104	42,202	2,768	1,809	3,841	2,000	4,000	7,957	16,696	16,946	35,224	28,321	Nil	54,501	Nil	42,986	2,668	5,178
TOTAL MALAYA	6,104	58,052	25,770	18,779	39,571	16,858	34,987	7,962	16,703	16,953	35,235	41,951	16,703	83,530	35,235	60,957	25,056	5,178

TABLE II

DEALERS' STOCKS, IN DRY TONS 3

Class of Rubber	Federated Malay States	S'pore	Penang	Province We'sly D'dings M'cca.	Johore	Total
20	21	22	23	24	25	26
Smoked sheet	11,597	19,952	3,411	2,348	912	38,720
Crepe	680	10,288	1,127	723	171	12,995
Unsmoked sheet / Scrap and lump	1,637 / 1,096	3,911	509	217	(668 / 556)	8,594
Total all Grades	15,016	34,151	5,047	3,788	2,307	60,309

TABLE III

FOREIGN EXPORTS

PORTS	For month	during the year 1931
Singapore ...	26,043	51,795
Penang ...	11,425	21,540
Port Swettenham.	3,993	8,756
Malacca ...	490	1,439
MALAYA ...	41,951	83,530

TABLE IV

THE PROPORTION OF FOREIGN EXPORTS REPRESENTING DOMESTIC PRODUCTION 4

AREA	For month	during the year 1931
Malay States ... / Straits Settlements	33,477	66,552
MALAYA ...	33,477	66,552

Notes :—1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained.

2. The production of estates of less than 100 acres is estimated from the formula : Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month, *i.e.*, Column [7] = Columns [13] + [14] + [17] + [18] + [19] − [2] − [3] − [4] − [5] − [9] − [10] For the Straits Settlements, the figure is an estimate based on the average found for the year 1930.

3. Dealers' stocks in the Federated Malay States are reduced to dry weights by the following fixed ratios: unsmoked sheet, 15%; wet sheet, 25%; scrap, lump, etc., 40%; stocks elsewhere are in dry weights as reported by the dealers themselves.

4. The proportion of foreign exports representing Malayan domestic production is estimated by deducting the average monthly dry weight of foreign imports over a period of 2 months from the gross foreign exports of the later month, the foreign exports of the Malay States being domestic production.

5. The above, with the omission of certain explanatory notes, is the Report published by J. I. Miller, M. C. S., Acting Registrar-General of Statistics, S.S. and F.M.S., at Singapore on March, 20, 1931.

GENERAL RICE SUMMARY.

February 1931.

Malaya.—57,780 tons of rice were imported and 13,700 exported as compared with 75,962 tons for the corresponding period last year. Of the total imports 52 per cent. was from Siam, 35 per cent. from Burma, 11 per cent. from French Indo-China and 2 per cent. from other countries.

The average declared value of imports of rice into Malaya for the first two months of 1931 was $4.80 per picul as compared with $7.13 for the corresponding period last year. Retail prices were :—Singapore 35 cents, Penang 40 cents and Malacca 35 cents per gantang as compared with last year's averages of Singapore 50, Penang 52 and Malacca 50.

The Malayan padi reports for February show but slight increases in the areas planted over those published in the March issue of this Journal.

In most cases harvesting has been completed or is in progress. Field estimates are not yet available.

India.—The total area planted is reported as 81,986,000 acres—an increase of 1,507,000 acres as compared with last year. It is estimated this year's yield will be 1 per cent. higher than that of last year and the general condition of the crop is reported as good.

Burma.—The latest official forecast of out-turn amounts to 7,609,000 tons (Rice). This differs but little from earlier estimates.

Formosa.—This year's crop promises to be 7.2 per cent. over that harvested last year and 11 per cent. higher than the average crop of the past five years.

General.—Almost without exception, reports from all rice prdoucing districts show a greater area planted and higher estimate of yield for this season than for the previous season.

The following notes and tables will be of interest.

French Indo-China.—Entries of padi at the port of Cholon and exports of rice from Saigon from 1st to 31st January (*Chambre de Commerce de Saigon Bulletin Bi-Mensuel*) were, in 000 metric tons :—

1st to 31st January	1931	1930
Entries of Padi	49	123
Exports of Rice	51	93.

Ceylon.—Imports into Ceylon during January were (in tons) :—

	From Br. India.	Burma.	Straits.	Others†	Total.
1928	8,325	23,991	5,809	894	39,019
1929	—	35,275	1,135	355	36,765
1930	10,811	35,792	125	2,268	48,997
1931	8,719	29,754	130	2,263	40,866

† Including the Maldive Islands, Cochin-China, India, Japan and Siam.

Siam.—Average wholesale Siam rice prices per ton in Singapore, were in dollars (Straits) :—

	1930	1931		Increase(+) or Decrease(—)% on previous month.
	Average Jan.-Dec.	January	February	
Singapore No. 1 ...	130	94	89	— 5.3
Singapore No. 2 (Special) ...	118	85	80	— 5.9
Singapore No. 2 (Ordinary)	108	76	73	— 4.0
Siam White Broken A. 1 ...	86	58	51	— 12.1
Siam White Broken C. 1 ...	81	55	48	— 12.7

The stocks of rice in Singapore, Penang and Malacca during the following periods were (in 100 tons) :—

1930				1931
September	October	November	December	January
25,730	17,678	13,492	22,691	15,854

Percentage Imports of Rice from different Countries during February, 1930 and 1931.

From	1930	1931	1931 compared with 1930.
	per cent.	per cent.	per cent.
Siam ...	56	52	— 4
Burma ...	37	35	— 2
French Indo-China ...	6	11	+ 5
Other Countries ...	1	2	+ 1
Total	100	100	—

Miscellaneous.—The following is an extract from the *Indian Trade Journal* of February 26, 1931 :—

"From the latest available bulletin published by the International Institute of Agriculture, Rome, it appears that the Estimates of the 1930—31 rice crop of the United States of America are 960,000 acres and 831,000 tons of rough rice, showing an increase of 11 per cent. in area and 2 per cent. in yield as compared with 1929—30 crop.

In Italy, the area and yield of rough rice are 360,000 acres and 641,000 tons, as against 339,000 acres and 663,000 tons in 1929—30."

METEOROLOGICAL SUMMARY, MALAYA. FEBRUARY, 1931.

Locality	Air Temperature in degrees Fahrenheit							Earth Temperature		Rainfall									Bright Sunshine			
	Means of			Absolute Extremes						Total		Most in a day	Number of days						Total	Daily Mean	Per cent	Length of Day
	A. Max.	B. Min.	Mean of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet			Amt.	Precipitation* .01 in or more	Precipitation, .04 in or more	Thunder-storm	Thunder heard	goF morning obs.	Gale force 8 or more				
	°F	°F	°F	°F	°F	°F	°F	°F	°F	in.	mm.	in.							hr.	hr.	%	hr.
Railway Hill, Kuala Lumpur, Selangor ...	93.5	72.3	82.9	97	69	90	75	84.7	84.5	4.48	113.8	2.94	8	7	...	11	3		227.85	8.14	68	12.0
Bukit Jeram, Selangor ...	90.5	73.1	81.8	93	71	85	75	86.6	87.4	2.47	63.7	1.38	10	7	2	15	2		266.10	9.50	80	12.0
Sitiawan, Perak ...	91.8	72.6	82.2	94	70	88	76	85.2	84.5	4.69	119.1	3.58	5	4	5	10	1		257.20	9.19	...	...
Kroh, Perak ...	91.4	66.6	79.0	94	59	86	73	81.0	81.8	0.74	18.8	0.50	7	5	...	4	...		255.00	9.11	...	...
Temerloh, Pahang ...	90.3	71.6	80.9	92	67	85	76	85.1	84.6	2.07	52.6	1.64	4	4	...	7	12		230.85	8.24	69	12.0
Kuala Lipis, Pahang ...	90.1	70.6	80.3	93	67	83	73	83.5	83.3	1.96	49.8	0.61	8	8	1	5	13		221.30	7.90	66	12.0
Kuala Pahang, Pahang ...	85.9	74.9	80.4	88	71	83	79	84.7	84.3	2.87	72.9	1.30	8	6	1	4	...		258.90	9.25	...	12.0
Mount Faber, Singapore ...	90.4	73.8	82.1	92	71	88	76	81.4	82.0	5.91	150.1	2.35	10	7	3	5	...		199.10	7.11	60	12.1
Butterworth, Province Wellesley ...	90.4	73.6	82.0	96	71	87	77	85.9	84.7	1.26	32.0	0.33	9	9	1	9	...		284.70	10.17	...	...
Bukit China, Malacca ...	90.1	74.2	82.1	93	70	85	76	85.1	84.5	1.71	43.4	1.25	6	5	3	7	...		249.65	8.92	74	12.1
Kluang, Johore ...	90.9	72.3	81.6	94	68	87	75	82.7	82.3	0.96	24.4	0.43	7	5	1	6	2		218.15	7.79	84	12.1
Bukit Lalang, Mersing, Johore	85.1	74.0	79.5	88	69	84	78	81.3	81.0	2.40	61.0	0.84	9	5	...	1	...		242.40	8.66	72	12.1
Alor Star, Kedah ...	93.8	69.8	81.8	96	62	90	76	84.8	85.5	1.17	29.7	0.55	4	4	...	3	...		274.45	9.80	82	11.9
Kota Bharu, Kelantan ...	87.0	71.1	79.1	89	67	83	76	82.1	82.7	2.31	58.7	0.72	10	7	...	1	...		244.50	8.73	73	11.9
Kuala Trengganu, Trengganu	86.0	71.4	78.7	87	68	80	75	82.5	82.7	4.69	119.1	2.31	9	8	...	1	6		252.30	9.01	75	12.0
HILL STATIONS.																						
Cameron's Highlands, Rhodendron Hill, Pahang 5120 ft. ...	74.1	58.7	66.4	77	55	69	61	...	...	2.07	52.6	0.86	8	8	...	6	...		193.20	6.90	60	12.0
Cameron's Highlands, Tanah Rata, Pahang 4750 ft. ...	73.6	54.2	63.9	76	45	70	63	69.2	68.9	2.11	53.6	0.87	10	7	...	8	1		193.20	6.90	60	12.0
Fraser's Hill, Pahang 4268 ft.	72.8	60.9	66.9	78	57	68	64	71.7	71.5	7.61	193.3	2.66	11	11	...	6	17	2	189.30	6.76	56	12.0

*Precipitation .01 inch or more when measurement is in inches .2mm. or more when measurement is in millimetres.
Compiled from Returns supplied by the Meteorological Branch, Malaya.